Bat Fatality Rates and Effects of Changes in Operational Cut-in Speeds at Commercial Wind Farms in Southern Minnesota – Year 1

July 9 – October 31, 2013

Prepared for:

Minnesota Department of Commerce

85 Seventh Place East, Suite 500
St. Paul, Minnesota 55101

Prepared by:

Kristen Chodachek, Clayton Derby, Donna Bruns Stockrahm,

Paul Rabie, Kristen Adachi, and Terri Thorn

Western EcoSystems Technology Inc.
4007 State Street, Suite 109
Bismarck, North Dakota 58503

&

Minnesota State University Moorhead
1104 Seventh Avenue South
Moorhead, Minnesota 56563

May 23, 2014

WEST Inc.

1.0 EXECUTIVE SUMMARY

The Minnesota Legislature established a Renewables Portfolio Standard in 2007 that will require utilities in the State to obtain 25% of their energy production from renewable resources by 2025. Based on current technology and conditions, it is most likely that the largest share of this portfolio will be met through wind energy development. Currently, Minnesota is one of the top producers of wind power in the nation. To date, much of the recent permitting has been based on wildlife studies from the late 1990's and early 2000's. Since that time, wind turbine technology changed considerably, as have the development locations within Minnesota. With these changes, updated information on impacts to bats and birds is needed. The purpose of this study is to evaluate the fatality risk to bats at wind facilities within Southern Minnesota. Year one of the 4-year study is to determine baseline bat fatality rates and evaluate possible correlations between turbine site characteristics and estimated fatality rates.

Fatality monitoring was conducted from early July through October 31, 2013 at the Big Blue Wind Farm, LLC (Big Blue), Grand Meadow Wind Farm (Grand Meadow), and Oak Glen Wind Farm (Oak Glen). Monitoring included carcass searching, and searcher efficiency and carcass removal trials to estimate potential sources of bias. Fatality estimates were calculated using Shoenfeld (2004), Huso (2011), and Empirical Pi estimators.

To compare to other studies in the region, the Shoenfeld estimator was primarily used since several other studies in the Midwest have used this estimator. Overall, bat fatality rates at Big Blue (6.33 bat fatalities per megawatt [MW] year), Grand Meadow (3.11 bat fatalities/MW/year), and Oak Glen (3.09 bat fatalities/MW/year) are within the range reported for fatality rates at other facilities in the Midwest. Eastern red bats and hoary bats composed the majority of bat fatalities at each facility, which is similar to the proportions reported by other wind-energy facilities in the region. Based on the timing of fatalities and habitat requirements for these bat species, most of the fatalities are likely migrating bats, a common trend reported at other wind energy facilities in North America. No state or federally endangered or threatened bat species were found as fatalities.

A combined total of 16 bird fatalities were found at Big Blue, Grand Meadow, and Oak Glen. Due to the focus of the study on bat fatalities, bird fatality estimates are not comparable with regional or national estimates.

Due to the small sample size of fresh bat fatalities found during Year 1, a logistic model was used rather than the negative binomial model. For all three facilities, the probability for one or more bat fatalities had the highest linear correlation with rotor speed and variability in wind speed (i.e. standard deviation of wind speed).

STUDY PARTICIPANTS

Western EcoSystems Technology

Clayton Derby	Principal Investigator
Kristen Chodachek	Project Manager
Goniela Iskali	Field Supervisor
Paul Rabie	Senior Biometrician
Kristen Adachi	Biometrician
Terri Thorn	GIS Specialist
Andrea Palochak	Technical Editor
Damon Haan	Technician
Kori Hutchison	Technician

Minnesota State University Moorehead

Donna Bruns Stockrahm	Consulting Biologist
Kristen Wittman	Student Intern
Scott Kleindl	Student Intern
Kara Nygaard	Student Intern
Amie Nowacki	Student Intern

REPORT REFERENCE

Chodachek, K., C. Derby, D. Bruns Stockrahm, P. Rabie, K. Adachi, and T. Thorn. 2013. Bat Fatality Rates and Effects of Changes in Operational Cut-in Speeds at Commercial Wind Farms in Southern Minnesota – Year 1. July 9 – October 31, 2013. Prepared for Minnesota Department of Commerce, St. Paul, Minnesota. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota, and Minnesota State University Moorhead (MSUM), Moorhead, Minnesota.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

2.0 INTRODUCTION

The Minnesota Legislature established a Renewables Portfolio Standard (RPS) in 2007 that will require utilities in the State to obtain 25% of their energy production from renewable resources by 2025. Based on current technology and conditions, it is most likely that the largest share of this RPS will be met through wind energy development. It is clear that Minnesota has placed a high level of importance on renewable energy, that a large proportion of the future needs for renewable energy will be met through wind power, and that the state will need to permit numerous wind facilities in the coming years. To date, much of the recent permitting in Minnesota has been based on information collected at the Buffalo Ridge wind resource area in the late 1990s and early 2000s. Since that time, wind turbine technology has expanded greatly (i.e., many turbines in the Buffalo Ridge area are less than 0.5 megawatts [MW] and many of today's modern turbines are 2.0 MW and larger) and wind facilities are moving into new ecoregions within Minnesota. With these changes, updated information on impacts to bats and birds is needed. Current estimates of impacts to bats in the Midwest vary greatly, from 0.16 to over 30 bat fatalities/MW/year, and it appears that higher bat fatalities may be found in portions of Wisconsin, Iowa, and eastern Minnesota, compared to western Minnesota and the Dakotas.

The purpose of this study is to evaluate the fatality risk to bats at wind facilities in southern Minnesota. Year one of the 4-year study is to begin to determine baseline bat fatality rates and evaluate possible correlations between turbine site characteristics and estimated fatality rates. The monitoring also allows for an investigation of bird fatalities; however bird fatality estimates will be used to determine if unusually large, unexpected numbers of bird fatalities are occurring.

The wind facilities included in the study are the Big Blue Wind Farm, LLC (Big Blue), Grand Meadow Wind Farm (Grand Meadow), and Oak Glen Wind Farm (Oak Glen). Big Blue is located approximately three miles (4.8 kilometers [km]) southwest of Blue Earth, Minnesota, within Jo Daviess Township, Faribault County. The facility consists of 18 Gamesa G97 2.0-MW turbines with a capacity of 36 MW (Figure 2.0-1a). The turbine towers are 256 feet (ft; 78 meters [m]) high with a 318 ft (97 m) blade diameter, resulting in a rotor swept height (RSH) of 156 to 412 ft (47.5 to 125.6 m) above ground level (AGL). Big Blue became operational in December 2012. Grand Meadow is located approximately one mile (1.6 km) southeast of Dexter, Minnesota, within Grand Meadow, Clayton, and Dexter Townships in Mower County. Grand Meadow consists of 67 GE 1.5-MW SLE turbines (Figure 2.0-1b), with the capacity of producing 100.5 MW of power. Each turbine has a 213 ft (80 m) hub height and a 253 ft (77 m) rotor diameter, resulting in a RSH of 126 to 340 ft (38.5 to 103.5 m) AGL. Grand Meadow became operational December 2008. Oak Glen is located approximately three miles (4.8 km) south of Bixby, Minnesota, within Blooming Prairie Township, Steele County. The facility consists of 24 V90 1.8-MW Vestas turbines with a capacity of 44 MW (Figure 2.0-1c). The turbine towers are 262 ft (80 m) high with a 289 ft (88 m) blade diameter, resulting in a RSH of 144 to 407 ft (44 to 124 m) AGL. Oak Glen became operational in October 2011.

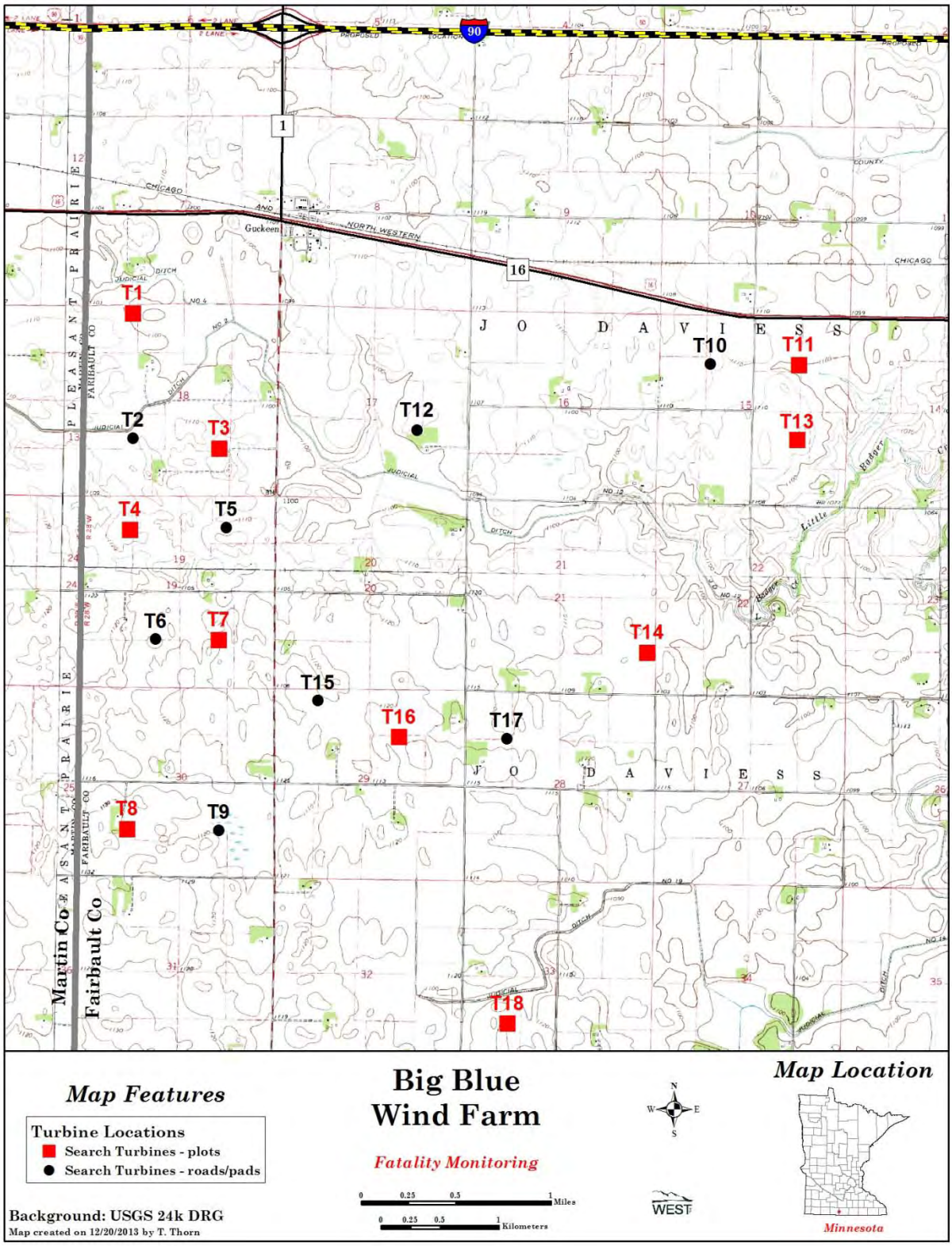


Figure 2.0-1a. Location of the Big Blue Wind Farm and turbines.

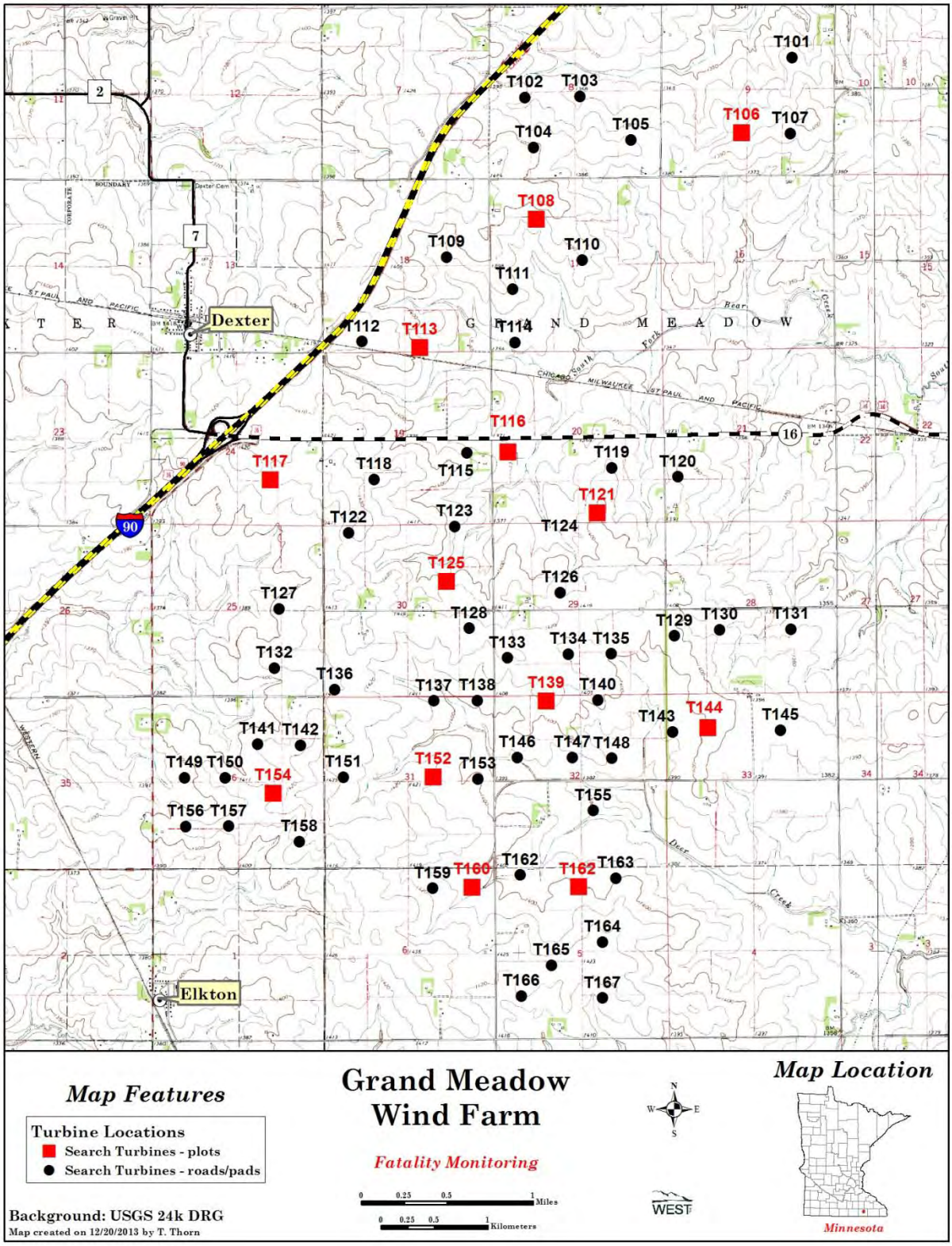


Figure 2.0-1b. Location of the Grand Meadow Wind Farm and turbines.

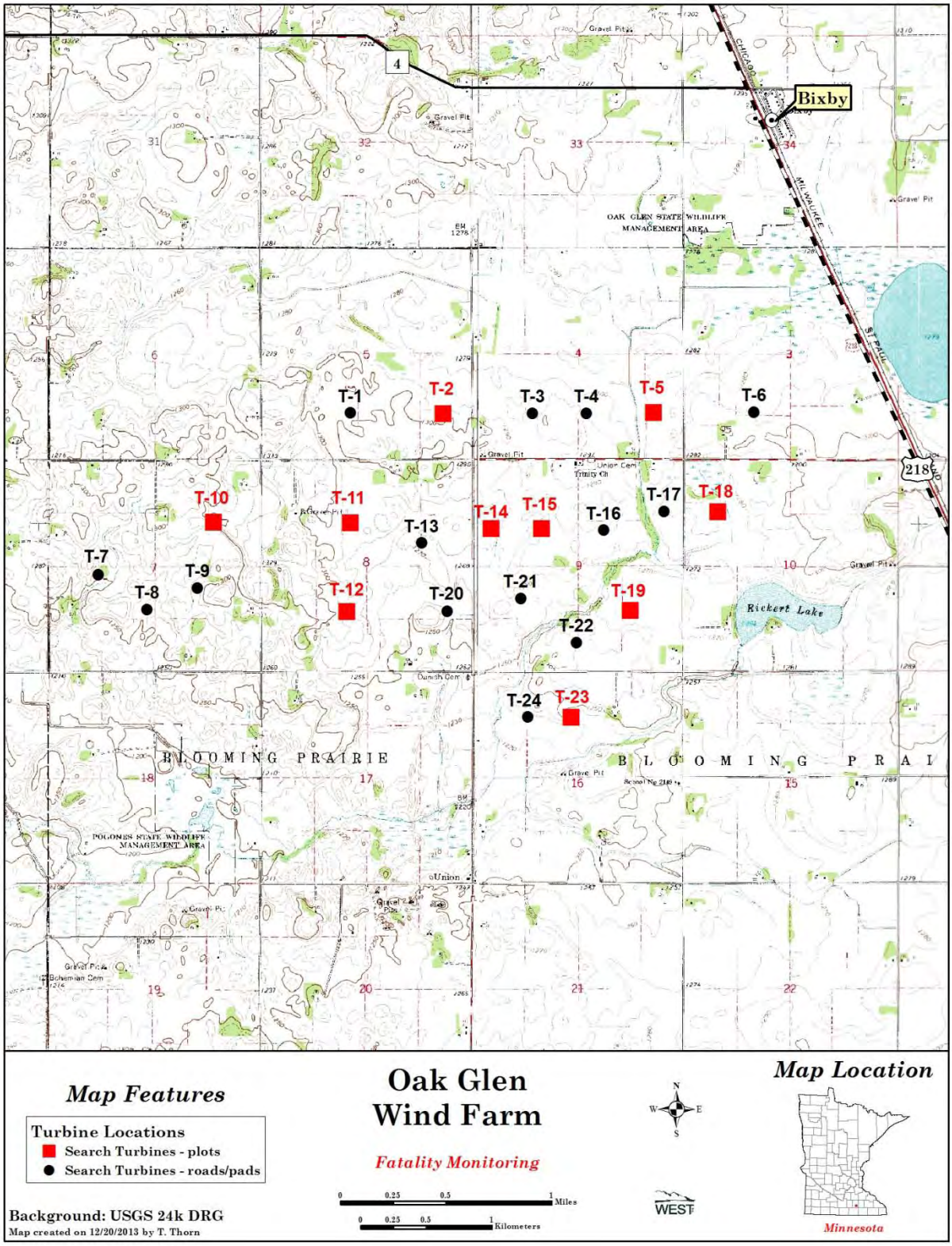


Figure 2.0-1c. Location of the Oak Glen Wind Farm and turbines.

3.0 STUDY AREA

All three facilities are located within the Western Cornbelt Plains Ecoregion (Chapman et al. 2001, 2001b). This ecoregion covers much of Iowa and portions of southern Minnesota and eastern Nebraska. Historically covered by tallgrass prairie, the Western Cornbelt Plains Ecoregion has largely been converted to tilled agriculture, predominantly (*Zea mays*) and soybean (*Glycine max*) fields, with smaller amounts of pastureland (Appendix A).

Using the Minnesota Department of Natural Resources (MDNR) ecological classification system, Big Blue is located within the Minnesota River Prairie ecological subsection; while Grand Meadow and Oak Glen are within the Oak Savannah subsection (2014). Similar to the Western Cornbelt Plains, both the Minnesota River Prairie and Oak Savannah subsections have been converted to agricultural lands.

4.0 METHODS

The fatality monitoring study consisted of the following components:

1) standardized carcass surveys at all turbines,
2) searcher efficiency trials to estimate the percentage of carcasses found by searchers, and
3) carcass removal trials to estimate the length of time that a carcass remained in the field for possible detection.

All casualties located within areas surveyed, regardless of species, were recorded and a cause of death was determined if possible. The total number of bat and bird casualties (including dead and injured bats and birds) were estimated by adjusting for search frequency, removal bias (length of stay in the field), searcher efficiency bias (percent found), and area searched. For carcasses where the cause of death was not apparent, the assumption that the fatality was caused by a wind turbine collision was made for the analysis. This approach likely led to an overestimate of the true number of facility-related bird fatalities, however is unknown for bats.

4.1 Carcass Searches

4.1.1 Seasons

Since the study was focused on bat mortality, monitoring was conducted from early July – October 31 at each wind facility, a period corresponding to the likely highest fatality and use period for bats in Minnesota and the region.

4.1.2 Sample Size, Search Area, and Search Frequency

Twenty percent or a minimum of 10 turbines were selected from each facility (Big Blue - 10 turbines; Oak Glen – 10 turbines; Grand Meadow - 13 turbines; Figures 2.0-1a, 2.0-1b, 2.0-1c) for surveys conducted five days per week. A full 120 m X 120 m (394 ft X 394 ft) plot centered

on the turbine was searched. Turbines with full plots were selected to survey representative habitats and topography of each site, while achieving relatively even coverage. No crop clearing was conducted at any of the facilities. In addition to the turbines with search plots, roads and pads were searched at the remaining turbines at each site (Big Blue – seven turbines; Grand Meadow – 54 turbines; Oak Glen – 14 turbines). At the request of the project owner at Big Blue, turbine 12 was excluded from searches due to landowner conflicts.

For turbines with plots, a square search plot was centered on each turbine, with the minimum distance searched in any direction equal to 60 m (197 ft; Figure 4.1-1). This plot size was selected based on existing data showing that the majority of bat fatalities are found within 40 or 50 m (131 or 164 ft) of turbine bases. Transects were walked 10 m (33 ft) apart within each plot to sample the area under the structure (Figure 4.1-1). Transect spacing was adjusted from the original proposed spacing of six m (19.8 ft) due to the increase in search time for the smaller transect spacing. For road and pad searches, the searcher looked around the turbine pad, turbine driveway, and access roads within 60 m (198 ft) of the turbine (Figure 4.1-2). As such, the searcher would survey a distance of 60 m (198 ft) along the access road in either direction from the turbine for a combined distance of 120 m (396 ft).

All search plots at each facility were mapped three times throughout the survey period to document vegetation and visibility class. Visibility classes ranged from Class 1 (bare ground – 90% or greater) to Class 4 (little or no bare ground with 25% of vegetation greater than 12 inches [30 centimeters (cm)] in height). Breakdown by habitat and visibility class was calculated for each turbine (Appendix A).

Daily searches were conducted Monday through Friday at the full plot locations at each facility, except during a period from September 1 – September 23, 2013, when not all plots were searched due to continued crop spraying, resulting in health and safety concerns. During this time period, road and pads were only searched at full plot locations where crop spraying occurred. Furthermore, daily searches at all turbines were conducted. At the road and pad locations, searches were conducted two times per week with at least a 1-day break between searches. The exception to this search protocol was during September 1 – September 23, 2013 during crop spraying when all turbines were searched daily, regardless. Searches typically began at sunrise at each facility and continued through late afternoon until all turbines were searched for the day (approximately eight hours at Big Blue and Oak Glen and 10 hours at Grand Meadow).

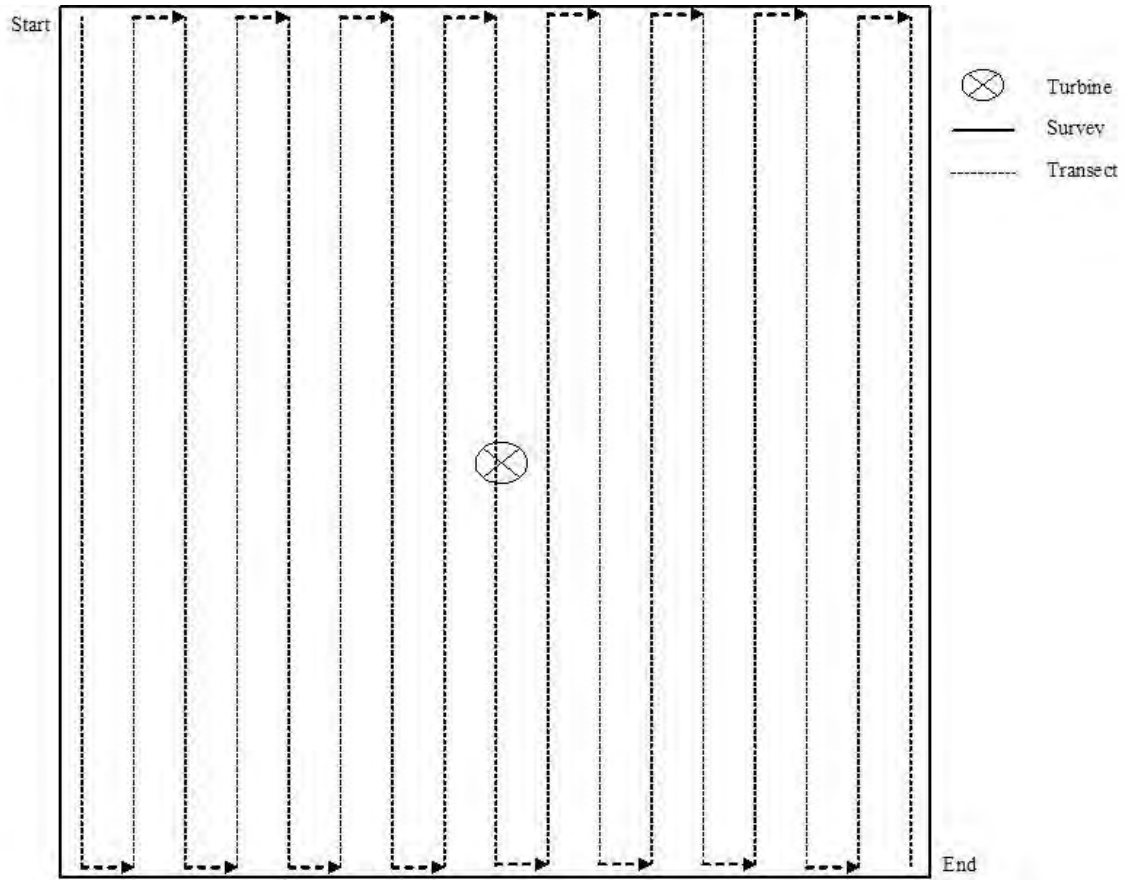


Figure 4.1-1. Example schematic of survey pattern (not to scale) for carcass search plots. Transects were placed 10 meters (33 feet) apart. Turbine pad and access road (not shown) were included in the area searched.

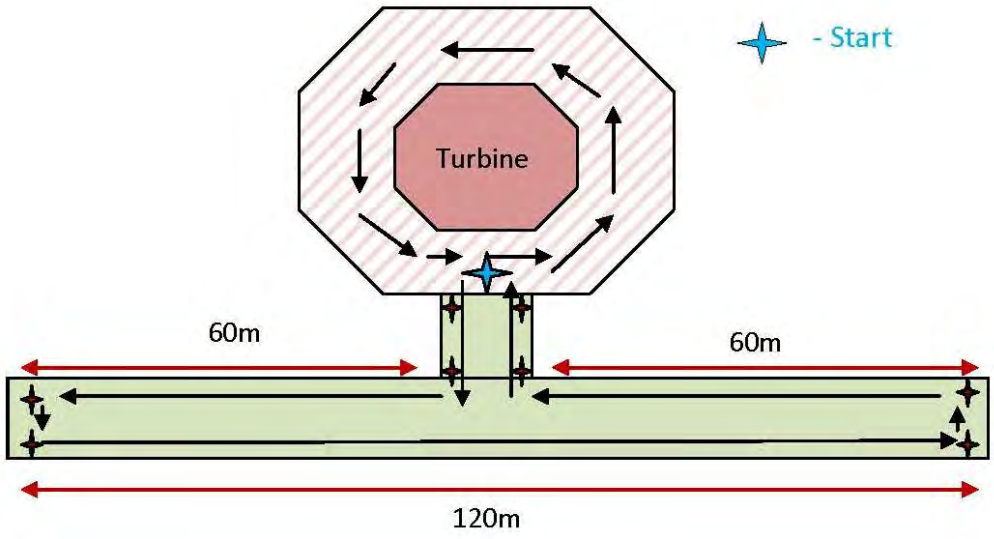


Figure 4.1-2. Example schematic of search area along road and turbine pad (not to scale; area searched varied, however all road and pad areas located within the 120 m x 120 m plot were surveyed).

4.1.3 Standardized Carcass Searches

Searches at Big Blue, Grand Meadow, and Oak Glen began in early July 2013 and continued through the end of October 2013. Personnel trained in proper search techniques conducted the carcass searches. Searchers looked for casualties, walking at a casual walking rate of approximately 45-60 m per minute (about 148-197 ft per minute) scanning the turbine pad, road, and transects spaced 10-m apart on the plots (Figure 4.1-1) and both the turbine pad and road for road/pad searches (Figure 4.1-2). To the extent possible, turbines searched were rotated throughout the day such that all daylight periods were surveyed (i.e., morning, mid-day, and afternoon). All turbines were searched once prior to the first carcass search to clear them of any bat and avian carcasses. These carcasses were not used in fatality estimates.

The condition of each bat and bird carcass found was recorded using the following categories:

- Intact - a carcass that is completely intact, is not badly decomposed, and shows no sign of being fed upon by a predator or scavenger; or
- Scavenged/Dismembered - an entire carcass, which shows signs of being fed upon by a predator or scavenger, or a portion(s) of a carcass in one location (e.g., wings, skeletal remains, portion of a carcass, etc.), or a carcass that has been heavily infested by insects.

For bird carcasses, the following category was also used in addition to the two categories listed above:

- Feather Spot - 10 or more feathers found at one location indicating predation or scavenging.

In addition to carcasses, any injured bats or birds observed in search plots or elsewhere in the wind facilities were recorded and treated as a fatality. All bat carcasses found on Grand Meadow and Oak Glen were collected, labeled with a unique number, and frozen for future reference and possible necropsy. A freezer tag documenting facility, date, observer, carcass identification number, time, species, and location (i.e. turbine number) was placed in the bag with the frozen carcass. For all bat and avian casualties found, data recorded included species, sex and age when possible, date and time collected, Universal Transverse Mercator (UTM) location, condition (intact, scavenged, feather spot), distance and bearing to turbine, and any comments that may indicate cause of death or injury. All bat and avian casualties located were photographed as found and plotted on a detailed map showing the location of the wind turbine and any associated facilities, such as overhead power lines and meteorological (met) towers. Avian casualties at Grand Meadow and Oak Glen were spray painted and left on site since a collection permit was not obtained. Due to concurrent fatality studies at Big Blue by another consultant, no bat or avian fatalities were collected, but carcasses were instead marked with a brown zip-tie around a foot. This gave the other consultant the opportunity to find the same carcass.

Bat and avian casualties found outside the formal search time but inside of search plots were treated following the above protocol as closely as possible and were included in the fatality estimate analysis. Bat and bird casualties found in non-search areas (e.g., near a transmission line) were coded as incidental discoveries and documented in a similar fashion as those found during standard searches, but these casualties were not included in the estimates of total fatalities.

4.2 Searcher Efficiency Trials

The objective of the searcher efficiency trials was to estimate the percentage of casualties that were found by the searchers. All carcasses were placed at random locations within areas being searched prior to the carcass search on the same day. Estimates of searcher efficiency were used to correct for detection bias by adjusting the total number of carcasses found for those missed by the searchers.

Searcher efficiency trials were conducted by placing "detection" carcasses along roads/pads or in full plots. Efficiency trials commenced with the start of carcass searches and were conducted periodically throughout each season at regularly searched turbines. Searchers conducting carcass searches did not know when the trials were being conducted or the locations where the "detection" carcasses were placed in a search plot. A total of 100 carcasses (50 mice, 25 small birds, and 25 large birds) each were placed for searcher efficiency trials throughout the study period at Big Blue, Grand Meadow, and Oak Glen. Carcasses used in trials were composed of commercially available species, such as dark hopper-sized house mice (*Mus musculus*; approximately 2-3 week old weaned mice) as bat surrogates; house sparrows (*Passer domesticus*) and 2 week old northern bobwhite quail (*Colinus virginianus*), for small birds; and rock pigeons (*Columba livia*) for large birds. Carcasses were placed at random locations in turbine plots with the constraint that proportion in each visibility class should be representative of the plots as a whole due to the use of random distances and azmiths for carcass placement. Each trial carcass was discreetly marked with a black zip-tie around the leg for birds and mice prior to placement so that it could be identified as a trial carcass.

Carcass placement occurred early in the morning, prior to turbine searches. Carcasses were dropped from waist height or higher and allowed to land in a random posture. To avoid attracting scavengers, no more than two carcasses were placed at any one turbine at any one time. The number and location of carcasses found during the subsequent carcass search was recorded. The number of carcasses available for detection during each trial was determined immediately after the trial by the trial administrator (non-searcher). Carcasses not found after the first search were left in the field in order to measure the probability of a searcher being able to find a bat or bird carcass during multiple searches. The carcass were left onsite for the 14 day carcass removal trial period; after which the carcasses were removed.

4.3 Carcass Removal Trials

The objective of carcass removal trials was to estimate the length of time bat and bird carcasses remained in the search area before being removed by scavengers or by other means. Carcass

removal includes removal by predation or scavenging, or removal by another means, such as being plowed in to a field. Carcass removal studies were conducted during each season concurrently with standardized carcass searching. Estimates of carcass removal were used to adjust carcass counts for removal bias.

Carcass removal trials were combined with searcher efficiency trials at Big Blue, Grand Meadow, and Oak Glen. As such, carcasses that were dropped for searcher efficiency trials were also used for carcass removal trials. Personnel conducting carcass searches monitored the trial carcasses over a 14-day period according to the following schedule as closely as possible. Carcasses were checked every day by a non-searcher for the first four days, and then on days seven, 10, and 14. The schedule varied slightly depending on weather and coordination with the other survey work. Experimental carcasses not removed by scavengers were left at the location until the end of the carcass removal trial. At the end of the 30-day period any remaining evidence of the carcass was removed.

4.4 Statistical Methods for Fatality Estimates

4.4.1 Quality Assurance and Quality Control

Quality assurance and quality control (QA/QC) measures were implemented at all stages of the study, including in the field, during data entry and analysis, and report writing. Following field surveys, observers were responsible for inspecting data forms for completeness, accuracy, and legibility. Potentially erroneous data were identified using a series of database queries. Irregular codes or data suspected as questionable were discussed with the observer and/or project manager. Errors, omissions, or problems identified in later stages of analysis were traced back to the raw data forms, and appropriate changes were made in all affected steps.

4.4.2 Data Compilation and Storage

A Microsoft® ACCESS database was developed to store, organize, and retrieve survey data. Data were keyed into the electronic database using a pre-defined format to facilitate subsequent QA/QC and data analysis. All data forms, field notebooks, and electronic data files were retained for reference.

4.4.3 Fatality Surveys

Estimates of facility-related fatalities are based on:

1) Observed number of carcasses found during standardized searches during the monitoring year for which the cause of death is either unknown or is probably facility-related;
2) Probability of detection including non-removal rates, expressed as the estimated average probability a carcass is expected to remain in the study area and be available for detection by the searchers during removal trials, and searcher efficiency, expressed as the proportion of planted carcasses found by searchers during searcher efficiency trials; and

3) Adjustment factor for fatalities found on a road and pad plots.

Fatality estimates were calculated for four categories: 1) all birds, 2) small birds, 3) large birds, and 4) bats.

4.4.4 Definition of Variables

The following variables are used in the equations below:

- c_i the number of carcasses detected at plot *i* for the study period of interest (e.g., one monitoring year), for which the cause of death is either unknown or is attributed to the facility
- k the number of turbines searched (including the turbines centered within each search plot)
- $\overline{c}$ the average number of carcasses observed per turbine per monitoring year
- s the number of carcasses used in removal trials
- s_c the number of carcasses in removal trials that remain in the study area after 30 days
- t_j the time (in days) carcass *j* remains in the study area before it is removed, as determined by the removal trials
- $\overline{t}$ the average time (in days) a carcass remains in the study area before it is removed, as determined by the removal trials
- R the average proportion of removal carcasses remaining throughout the search cycle
- p_s the estimated proportion of detectable carcasses found by searchers, as determined by single-day searcher efficiency trials
- $\hat{r}$ the probability that a carcass will remain in the study area and until the next scheduled carcass search
- I the average interval between standardized carcass searches, in days
- A proportion of the search area of a turbine actually searched
- $\hat{\pi}$ the estimated probability that a carcass is found during a search and was available
- m the estimated annual average number of bat fatalities per turbine per year, adjusted for removal and searcher efficiency bias and the estimated annual average number of bird fatalities per turbine per study period, adjusted for removal and searcher efficiency bias

4.4.5 Observed Number of Carcasses

The estimated average number of carcasses ($\bar{c}$) observed per turbine per monitoring year is:

$$\bar{c} = \frac{\sum_{i=1}^{n} c_i}{k}$$

The search area adjustment, *A,* is the ratio of the estimated number of carcasses that could have been found within search plots to the number of carcasses found within search plots to account for area within the plot that was not searched. The estimated number of carcasses is calculated by dividing the number of carcasses found in each 10-m distance band around the turbine by the proportion of the area searched within that band. The proportion within each band was calculated using a weighted average of area searched during full plot searches and road and pad searches based with visits as the weighting factor.

4.4.6 Estimation of Carcass Non-Removal Rates

4.4.6.1 Average Removal Time

Mean carcass removal time ($\bar{t}$) was the average length of time a carcass remains in the study area before it was removed:

$$\bar{t} = \frac{\sum_{j=1}^{s} t_j}{s - s_c}$$

where t_j when a carcass absent is given as the midpoint between the last search date on which it had been present, and the first search date on which it was absent and when the carcass is present at the end of the trial length is given as the last day the carcass was observed during the trial.

4.4.6.2 Proportion of Carcasses Persisting Through the Interval

The probability that a fatality will remain in the study area until the next scheduled carcass search ($\hat{r}$) depends on the removal rate and the search interval length (Huso 2011). The proportion of carcasses persisting through the interval was modeled with an exponential, Weibull, log-normal, and log-logistic regression. Model selection using AICcc values was completed to select the variables that best explain removal rates. The average probability of a carcass can be estimated with an exponential distribution as:

$$\hat{r} = \frac{\int_{x=0}^{I} e^{-x/\bar{t}} dx}{I},$$

a Weibull distribution as:

$$\hat{r} = \frac{\int_{x=0}^{I} e^{-(x/\bar{t})^{1/s}} dx}{I},$$

a log-normal distribution as:

$$\hat{r} = \frac{\int_{x=0}^{I} \Phi\left(ln\left(\frac{x}{\bar{t}}\right)^{1/s}\right) dx}{I},$$

and a log-logistic distribution as:

$$\hat{r} = \frac{\int_{x=0}^{I} \frac{1}{1+\left(\frac{x}{\bar{t}}\right)^{1/s}} dx}{I}$$

where *s* is a scale parameter.

4.4.7 Estimation of Searcher Efficiency Rates

4.4.7.1 Single-Search Searcher Efficiency Trials

Single-search searcher efficiency trial carcasses were placed at randomly selected search turbines on the day of carcass searches and were removed after carcass searches were completed. The searcher efficiency rate is expressed as p_s, and is given as the proportion of trial carcasses that were detected by searchers to the number of carcasses available during the carcass searches.

4.4.8 Estimation of Facility-Related Fatality Rates

The estimated per turbine annual fatality rate (*m*) is calculated by:

$$m = \frac{\bar{c}}{\hat{\pi} \cdot A}$$

where $\hat{\pi}$ includes adjustments for both carcass removal (from scavenging and other means) and searcher efficiency bias. If not statistically different across seasons or plot types, data for carcass removal and searcher efficiency bias will be pooled across the study. The Empirical Pi, Huso (2011), and Shoenfeld (2004) bias correction factors were used to estimate $\hat{\pi}$.

For bats, the fatality estimate was calculated as number of bat fatalities per turbine or megawatt per survey period. Survey period does not represent a calendar year for this study, rather represents the period of time surveys were conducted (i.e. late summer and fall). This survey period is typical of most post-construction wind studies for bats. For birds, the fatality estimate was calculated as number of bird fatalities per turbine or megawatt per study period. Study period was used for birds, since the majority of bird fatality studies at wind facilities require at least the spring, summer, and fall seasons to be considered a year. This ensures that the migration and breeding periods are included.

4.4.8.1 Empirical Bias Correction Factor

The empirical method depends on a balanced distribution of trial carcasses placed throughout the search interval. Empirical estimates for the probability of available and detected were calculated as follows:

$$\hat{\pi}_{Empirical} = \frac{\text{number of trial carcasses detected}}{\text{number of trial carcasses placed}}.$$

4.4.8.2 Shoenfeld Bias Correction Factor

The Shoenfeld bias correction factor combines single-search searcher efficiency with an exponential model related to the average number of searches before carcass removal to account for the ability of a carcass to be missed during a search but located on subsequent searches and an exponential model of carcass removal. The bias correction factor was independently verified by Shoenfeld (2004). $\hat{\pi}$ is calculated as follows:

$$\hat{\pi}_{Shoenfeld} = \frac{\bar{t} \cdot p_s}{I} \cdot \left[\frac{\exp\left(I/\bar{t}\right) - 1}{\exp\left(I/\bar{t}\right) - 1 + p_s} \right]$$

4.4.8.3 Huso Bias Correction Factor

The Huso (2011) estimator assumes that if a carcass was not seen on the first search it will not be seen on any subsequent searches. Removing carcasses with an estimated time since death greater than the search interval length in the Huso (2011) estimator corrects any bias associated with the assumption that a carcass can only be found on the first search (Personal Communication). The Huso bias correction factor is the product of the single-search searcher efficiency rate and proportion of carcasses persisting through the interval. The estimated per turbine annual fatality rate (*m*) is calculated by:

$$m = \frac{\bar{c}}{\hat{\pi} \cdot A}$$

where $\hat{\pi}$ includes adjustments for both carcass removal (from scavenging and other means) and searcher efficiency bias. If not statistically different across seasons or plot types, data for carcass removal and searcher efficiency bias will be pooled across the study. The Empirical Pi, Huso (2011), and Shoenfeld (2004) bias correction factors were used to estimate $\hat{\pi}$.

For bats, the fatality estimate was calculated as number of bat fatalities per turbine or megawatt per survey period. Survey period does not represent a calendar year for this study, rather represents the period of time surveys were conducted (i.e. late summer and fall). This survey period is typical of most post-construction wind studies for bats. For birds, the fatality estimate was calculated as number of bird fatalities per turbine or megawatt per study period. Study period was used for birds, since the majority of bird fatality studies at wind facilities require at least the spring, summer, and fall seasons to be considered a year. This ensures that the migration and breeding periods are included.
and is given as:

$$\hat{\pi}_{\text{Huso}} = p_s \hat{r}.$$

4.4.9 Search Area Adjustment for Roads and Pads

The calculation of the road and pad correction factor was based on a carcass density weighted area estimation using a Bayesian approach (Gelman et al 2013). The prior distribution of bat carcass distances from the turbine was based on public carcass data from 3499 fatalities at 77 wind projects in the United States. The observed distances on cleared plots were used to calculate a Bayesian posterior distribution of bat distances from the turbine, which in turn was used to calculate the proportion of fatalities expected to fall within each of eight, 10-m distance bands from a turbine.

The specification of the Bayesian prior followed a truncated normal prior distribution with truncation bounds of 0 m (at the turbine) and 60 m (the size of a search plot), and a mean and standard deviation of 9.09 ± 27.5 m (Casella and Berger 1990). The truncated normal prior was chosen from a list of candidate distributions based on AIC scores for fits to the carcass distance data (Burnham and Anderson 2002). Candidate distributions included the folded normal, exponential, gamma, Rayleigh, Rician, Gompertz and Weibull distributions, as well as mixture distributions of folded normals and truncated normals. Site-specific carcass data and a Gibbs sampler were used to determine the posterior density distribution of bat carcasses.

Road and pad configurations at the wind facility were digitized, and the proportion of each of six, 10-m distance bands (with respect to turbines) that were captured by road or pad area were calculated. Multiplying this proportion by the proportion of fatalities expected to fall within each of the distance bands and summing over the distance bands yielded a carcass density weighted area correction factor for the road and pad plots.

The reported estimates standard errors and 90% confidence intervals were calculated using bootstrapping (Manly 1997). Bootstrapping is a computer simulation technique that is useful for calculating point estimates, variances, and confidence intervals for complicated test statistics. Each bootstrap sample comprised a random resample from the fatality search data (with individual turbines as the unit of replication), the carcass removal data (with individual carcasses as the units of replication), and the searcher efficiency data (with individual carcasses as the units of replication). Bootstrap samples preserved sample sizes for turbines, large and small bird, or bat carcass removal carcasses, and large or small, or bat searcher efficiency carcasses. For each bootstrap sample, $\bar{c}$, $\bar{t}$, p_s, p_m, $\hat{\pi}_{Empirical}$, $\hat{\pi}_{Shoenfeld}$, $\hat{\pi}_{Huso}$, and *m* are calculated. A total of 1,000 bootstrap samples were used. The standard deviation of the bootstrap estimates is the estimated standard error. The lower 5th and upper 95th percentiles of the 1,000 bootstrap estimates are estimates of the lower limit and upper limit of 90% confidence intervals.

4.4.10 Weather and Fatality Correlation Analysis

Weather data used in this analysis were collected and compiled from several sources. Most data was collected using the meteorological (MET) towers onsite at each wind facility. Data

collected from MET towers included wind speed, wind direction, and rotor speed (Table 4.4-1). Additional weather data not available from MET towers including temperature, precipitation, and barometric pressure were collected from an online weather archive (Table 4.4-1; Weather Source, LLC 2013).

Environmental factors that contribute to the probability of bat fatalities were investigated with logistic regression. Only bat fatalities having time since death as last night or found fresh were included in the analysis. Due to a small sample size, a logistic model was used rather than the negative binomial model. With a reduced sample size, the negative binomial model would produce an inflated standard errors of the estimates as there is not enough data to model the number of bat fatalities per night per turbine. Alternatively, the logistic model provides a probability that one or more fatalities will occur, rather than an estimate of bat fatalities per turbine. Logistic models with a log link were considered, and the form was as follows:

$$\log(\mu) = \beta_0 + \beta_1 x_1 + \cdots + \beta_p x_p$$

This model relates the behavior of the natural logarithm of the probability of observing one or more fresh bat mortalities in a night to a linear function of the set of predictor variables $x_1, \ldots, x_p$. The model coefficients ($\beta_1, \ldots, \beta_p$) are the parameters that specify the nature of the relationship (Table 4.4-2). The program R was used to fit several models (R Development Core Team 2011).

All possible models were fit using the following variables: average nightly rotor speed, average nightly wind speed, average standard deviation of nightly wind speed, average nightly temperature, average nightly pressure, and an indicator for nightly precipitation. Correlations were obtained between all pairs of continuous variables (Table 4.4-3). Variables with pairwise correlations greater than or equal to 0.6 were not allowed to be present in the models simultaneously.

The most parsimonious logistic model to predict the odds of finding at least one bat fatality was selected based on Akaike Information Criterion (AIC). The AIC is a measure of the relative quality of a statistical model, for a given set of data. The AIC provides a means for model selection and deals with the trade-off between the goodness of fit of the model and the complexity of the model.

Table 4.4-1. List of weather covariates based on daily weather data collected for Big Blue, Grand Meadow, and Oak Glen Wind Farms, Minnesota, from July 9 to October 31, 2013.

Predictor Variable	Description	Units
Weather Variable*		
Average Pressure	Average station pressure. This is an average computed using up to 24 observations per day. If fewer than 24 observations (hourly observations) are available, the average is computed from the number of records available.	millibars (mb)
Average Temperature	Average nightly temperature. The average of hourly averages from temperature data collected at a MET tower or a weather station close to the facility.	degrees Celsius (°C)
Average Wind Speed	Average nightly wind speed at rotor swept height. This is an average of the 10 minute averages from all the wind turbines or MET towers with data	meters/second (m/s)
Standard Deviation of Wind Speed	Average standard deviation of nightly wind speed at rotor swept height. This is an average of the standard deviation of a 10 minute increment from all the wind turbines or MET towers with data	meters/second (m/s)
Total Precipitation	Total precipitation in a night collected at a weather station close to the facility*.	Inches (in)
Precipitation Indicator	An indication of precipitation from sunset to sunrise.	(0 for 'no' and 1 for 'yes')
Average Rotor Speed	Average nightly rotor rotations per minute (RPM). Calculate from the average of the 10 minute averages from all wind turbines with data.	rotations per minute (RPM)

* - data was collected from the wind farm and the nearest weather station to each wind facility offering hourly weather data.

Table 4.4-2a. Coefficients for eight multivariate models within two AIC units of the minimum at the Big Blue Wind Farm. Possible models for probability of bat fatalities considering subsets of covariates: Average Wind Speed, Average Pressure, Standard Deviation of Wind Speed, Average Temperature, and Precipitation Indicator.

AIC[1]	BIC[2]	(Intercept)	Average Wind Speed[3]	Average Wind Speed Squared	Average Pressure[4]	Standard Deviation of Wind Speed	Average Temperature[5]	Precipitation Indicator[6]
119.94	125.36	-0.328	NA	NA	NA	-1.668	NA	NA
120.08	128.21	-1.114	NA	NA	NA	-1.759	0.046	NA
120.14	125.56	-0.243	-0.153	NA	NA	NA	NA	NA
120.29	128.41	-1.027	-0.159	NA	NA	NA	0.045	NA
120.72	131.56	-3.034	0.528	-0.054	NA	NA	0.048	NA
120.77	126.19	-2.007	NA	NA	NA	NA	0.042	NA
120.85	128.97	-2.005	0.467	-0.048	NA	NA	NA	NA
121.93	130.06	-0.326	NA	NA	NA	-1.681	NA	0.033

1 – AIC – Akaike information criterion
2 – BIC – Bayesian information criterion.
3 –unit of measure is meters per second
4 – unit of measure is millibar
5 – unit of measure is degrees celcius
6 – 0 for ‘no’ and 1 for ‘yes’

Table 4.4-2b. Coefficients for five multivariate models within two AIC units of the minimum at the Grand Meadow Wind Farm. Possible models for probability of bat fatalities considering subsets of covariates: Average Rotor Speed, Average Wind Speed, Average Temperature, Average Pressure, and Precipitation Indicator.

AIC[1]	BIC[2]	(Intercept)	Average Rotor Speed[3]	Average Rotor Speed Squared	Average Wind Speed[4]	Average Wind Speed Squared	Average Temperature[5]	Average Pressure[6]	Precipitation Indicator[7]
100.27	111.11	-2.134	0.268	-0.025	NA	NA	0.110	NA	NA
101.72	112.56	-2.100	NA	NA	0.322	-0.076	0.106	NA	NA
101.94	110.07	-0.292	NA	NA	-0.442	NA	0.095	NA	NA
101.97	115.51	-2.127	0.280	-0.025	NA	NA	0.111	NA	-0.514
102.26	115.81	-7.135	0.270	-0.025	NA	NA	0.109	0.006	NA

1 – AIC – Akaike information criterion
2 – BIC – Bayesian information criterion
3 –unit of measure is rotations per minute
4 – unit of measure is meters per second
5 – unit of measure is degrees celcius
6 – unit of measure is millibar
7 – 0 for 'no' and 1 for 'yes'

Table 4.4-2c. Coefficients for six multivariate models within two AIC units of the minimum at the Oak Glen Wind Farm. Possible models for probability of bat fatalities considering subsets of covariates: Average Rotor Speed, Average Wind Speed, Average Temperature, Standard Deviation of Wind Speed, and Average Pressure.

AIC[1]	BIC[2]	(Intercept)	Average Rotor Speed[3]	Average Rotor Speed Squared	Average Wind Speed[4]	Average Wind Speed Squared	Average Pressure[5]	Standard Deviation of Wind Speed	Average Temperature[6]
85.92	96.68	-4.238	0.216	NA	NA	NA	NA	-3.656	0.143
86.64	97.40	-8.462	NA	NA	1.784	-0.168	NA	NA	0.152
87.14	95.21	-3.078	NA	NA	NA	NA	NA	-2.179	0.159
87.37	98.14	89.982	NA	NA	NA	NA	-0.095	-2.929	0.160
87.58	101.04	58.172	NA	NA	1.875	-0.180	-0.069	NA	0.154
87.84	101.30	-5.083	0.400	-0.011	NA	NA	NA	-3.449	0.146

1 – AIC – Akaike information criterion
2 – BIC – Bayesian information criterion
3 –unit of measure is rotations per minute
4 – unit of measure is meters per second
5 – unit of measure is millibar
6 – unit of measure is degrees celcius

Table 4.4-3a. Correlations between covariates used in weather correlation analyses at the Big Blue Wind Farm from July 9 to October 31 ,2013.

	Average Wind Speed	Maximum Wind Speed	Standard Deviation of Wind Speed	Average Temperature	Average Pressure	Total Precipitation
Average Wind Speed	1.00	0.99	0.79	0.07	-0.31	-0.12
Maximum Wind Speed	0.99	1.00	0.86	0.07	-0.35	-0.09
Standard Deviation of Wind Speed	0.79	0.86	1.00	0.06	-0.44	0.11
Average Temperature	0.07	0.07	0.06	1.00	-0.14	0.10
Average Pressure	-0.31	-0.35	-0.44	-0.14	1.00	0.00
Total Precipitation	-0.12	-0.09	0.11	0.10	0.00	1.00

Table 4.4-3b. Correlations between covariates used in weather correlation analyses at the Grand Meadows Wind Farm from July 12 to October 31, 2013.

	Average Rotor Speed	Average Wind Speed	Average Temperature	Average Pressure	Total Precipitation
Average Rotor Speed	1.00	0.93	0.16	-0.28	0.05
Average Wind Speed	0.93	1.00	0.19	-0.28	0.04
Average Temperature	0.16	0.19	1.00	0.18	0.02
Average Pressure	-0.28	-0.28	0.18	1.00	-0.16
Total Precipitation	0.05	0.04	0.02	-0.16	1.00

Table 4.4-3c. Correlations between covariates used in weather correlation analyses at the Oak Glen Wind Farm from July 15 to October 31, 2013.

	Average Rotor Speed	Average Wind Speed	Standard Deviation of Wind Speed	Average Temperature	Average Pressure	Total Precipitation
Average Rotor Speed	1.00	0.58	0.41	0.16	-0.17	0.08
Average Wind Speed	0.58	1.00	0.82	0.14	-0.28	0.09
Standard Deviation of Wind Speed	0.41	0.82	1.00	0.10	-0.39	0.33
Average Temperature	0.16	0.14	0.10	1.00	-0.03	0.04
Average Pressure	-0.17	-0.28	-0.39	-0.03	1.00	-0.13
Total Precipitation	0.08	0.09	0.33	0.04	-0.13	1.00

5.0 DISPOSITION OF DATA AND REPORTING STANDARDS

This monitoring study provides information on fatalities and total bat and bird mortality associated with operations of Big Blue, Grand Meadow, and Oak Glen, and the data used to evaluate the overall impacts of the facility on birds and bats. At the end of the study all data will be provided to the Minnesota Department of Commerce (MN DOC), including the data forms and electronic data files. During the study, the raw data forms were housed by WEST, and individual bat carcasses collected during the study were housed in three individual freezers for each facility, under a Minnesota State Collecting Permit.

6.0 RESULTS

Surveys at Big Blue, Grand Meadow, and Oak Glen began July 9, 2013, July 12, 2013, and July 15, 2013, respectively, and continued through October 31, 2013. All casualties (including dead and injured bats and birds) located within areas surveyed, regardless of species, were recorded and a cause of death or injury determined, if possible (no injured birds or bats were located during this study). Surveys were implemented using a standardized plot search method. Additional road and pad searches were conducted at the remaining turbines at all facilities. At Big Blue and Oak Glen, the sample size for turbines with road and pad searches was not sufficient to develop an independent estimate of fatality rate; however, bat and bird fatalities were included to provide additional data for species composition and fatality timing information. At Grand Meadow, the sample size was sufficient to develop an estimated fatality rate using the road and pad information. Results of the standardized carcass searches for bats and birds, searcher efficiency, carcass removal trials, and adjusted fatality estimates for bats and birds are discussed in the sections below.

6.1 Search Area and Habitat

Total area searched, percent area searched as a function of the maximum search area, and the proportion of detection types for roads and pads were calculated (Table 6.1-1; Appendix B). The proportion of area searched for road and pads was greatest from zero to 10 m, however, area decreased considerably from the 20-m (66-ft) band up to the 90-m band for all three wind facilities (Table 6.1-1). Amount of area searched at all three facilities was similar for each 10-m band for the road and pads (Table 6.1-1).

Table 6.1-1. Percent of the area searched in 10-meter (m) bands at the Big Blue, Grand Meadow, and Oak Glen Wind Facilities for other road and pad search areas (i.e. non-plot turbines).

	Percent Area Searched		
Distance (m)	**Big Blue**	**Grand Meadow**	**Oak Glen**
0-10	61.30	60.72	51.52
11-20	6.36	8.99	6.15
21-30	4.38	4.41	3.21
31-40	3.43	3.45	2.74
41-50	3.56	2.91	2.33
51-60	3.71	2.56	2.09
61-70	3.32	1.47	1.24
71-80	4.25	1.23	1.42
81-90	0.32	0.04	1.79

6.2 Standardized Carcass Surveys

6.2.1 Summary of Search Effort

Surveys at Big Blue, Grand Meadow, and Oak Glen began on July 9, 2013, July 12, 2013, and July 15, 2013, respectively, and continued through October 31, 2013. Surveys were not initiated on the anticipated start date of July 1, 2013, to allow sufficient time for contracting and site access agreements. During the period of September 1 through September 23, 2013, only roads and pads were surveyed for all turbines at Big Blue, Grand Meadow, and Oak Glen because ongoing aerial and ground crop spraying was resulting in health and safety concerns. Additionally, turbines were not searched during inclement weather or when facility operations personnel or local landowners were working at the turbine or the field surrounding the turbine because of health and safety concerns.

A total of 754 surveys were conducted at plots during 82 visits at Big Blue. Between four and 10 turbines were searched daily after initial site set up (Appendix C-1). Turbine 12 initially started out as a full plot; however, on July 20, 2013, at the request the owner/operator of Big Blue, WEST dropped this turbine and replaced it with turbine 13. As such, these two turbines had fewer visits for the survey period (Appendix C-1). Searches at road and pad turbines were typically conducted twice per week, with the exception of turbines 6 and 10 (Appendix C-1). Both of these turbines were visited an additional time during the survey period.

At Grand Meadow, a total of 791 surveys were conducted at plots during 77 visits. Between four and 10 turbines were searched daily after initial site set up (Appendix C-2). Surveys at the road and pad turbines were not consistently searched until the week of August 12, 2013, due to a miscommunication. After this point, these turbines were typically searched twice per week (Appendix C-2).

A total of 741 surveys were conducted at plots during 76 visits at Oak Glen. Between seven and 10 turbines were searched daily after initial site set up (Appendix C-3). Searches at road and pad turbines were typically conducted twice per week (Appendix C-3).

6.2.2 Bat Fatalities

6.2.2.1 Characteristics of Bat Fatalities

Overall, a total of 199 bat fatalities were found during standardized carcass surveys (excluding incidentals) at all three facilities combined in 2013 (Tables 6.2-1a – 6.2-1f). A total of 91 bat fatalities (Plot – 77 bat fatalities; Road/Pad – 14 bat fatalities) were found at Big Blue, 69 bat fatalities (Plot – 30 bat fatalities; Road/Pad – 39 bat fatalities) at Grand Meadow, and 39 bat fatalities (Plot – 28 bat fatalities; Road/Pad – 11 bat fatalities) at Oak Glen. Eastern red bats (*Lasiurus borealis*) and hoary bats (*Lasiurus cinereus*) were the dominant bat species found at all three facilities, making up 39.7% and 28.1%, respectively, of all fatalities (Tables 6.2-1a – 6.2-1f). Other species of bat fatalities found included little brown bat (*Myotis lucifugus*), silver-haired bat (*Lasionycteris noctivagans*), big brown bat (*Eptesicus fuscus*), and tri-colored bat (*Perimyotis subflavus*). No state or federally endangered or threatened bat species were found. The number, location, other characteristics of the bat fatalities, and the fatality estimates adjusted for searcher efficiency and carcass removal biases are discussed below.

6.2.2.2 Distribution of Bat Fatalities: Temporal Patterns

At Big Blue, Grand Meadow, and Oak Glen, bat fatalities peaked twice; once in late July/early August and again late August/early September (Figures 6.2-1a – 6.2-1f).

Table 6.2-1a. Total number of bat casualties and the composition of casualties discovered on the 120-m x 120-m plots at the Big Blue Wind Farm from July 9 – October 31, 2013*.

	Fatalities during Scheduled Searches		Incidental Fatalities On Search Plots		Incidental Fatalities Off Search Plots		Total	
Species	**Total**	**% Comp.**	**Total**	**% Comp.**	**Total**	**% Comp.**	**Total**	**% Comp.**
eastern red bat	43	55.8	0	0	1	33.3	44	55.0
hoary bat	13	16.9	0	0	1	33.3	14	17.5
big brown bat	7	9.1	0	0	1	33.3	8	10.0
little brown bat	7	9.1	0	0	0	0	7	8.75
silver-haired bat	7	9.1	0	0	0	0	7	8.75
Overall Bats	**77**	**100**	**0**	**0**	**3**	**100.0**	**80**	**100**

* - Roads and Pads, not full plots were searched from September 1 - 23, 2013 due to crop spraying,

Table 6.2-1b. Total number of bat casualties and the composition of casualties discovered on roads and pads at the Big Blue Wind Farm from July 9 – October 31, 2013.

	Fatalities during Scheduled Searches		Incidental Fatalities On Search Plots		Incidental Fatalities Off Search Plots		Total	
Species	**Total**	**% Comp.**	**Total**	**% Comp.**	**Total**	**% Comp.**	**Total**	**% Comp.**
eastern red bat	6	42.9	0	0	0	0	6	40.0
hoary bat	6	42.9	0	0	0	0	6	40.0
little brown bat	1	7.14	0	0	0	0	1	6.7
silver-haired bat	1	7.14	0	0	0	0	1	6.7
big brown bat	0	0	0	0	1	1	1	6.7
Overall Bats	**14**	**100**	**0**	**0**	**1**	**1**	**15**	**100**

Table 6.2-1c. Total number of bat casualties and the composition of casualties discovered on the 120-m x 120-m plots at the Grand Meadow Wind Farm from July 12 – October 31, 2013.

	Fatalities during Scheduled Searches		Incidental Fatalities On Search Plots		Incidental Fatalities Off Search Plots		Total	
Species	**Total**	**% Comp.**	**Total**	**% Comp.**	**Total**	**% Comp.**	**Total**	**% Comp.**
hoary bat	14	46.7	0	0	1	50.0	15	46.9
eastern red bat	11	36.7	0	0	1	50.0	12	37.5
little brown bat	3	10.0	0	0	0	0	3	9.4
big brown bat	1	3.3	0	0	0	0	1	3.1
silver-haired bat	1	3.3	0	0	0	0	1	3.1
Overall Bats	**30**	**100**	**0**	**0**	**2**	**100**	**32**	**100**

* - Roads and Pads, not full plots were searched from September 1 - 23, 2013 due to crop spraying,

Table 6.2-1d. Total number of bat casualties and the composition of casualties discovered on roads and pads at the Grand Meadow Wind Farm from July 12 – October 31, 2013.

	Fatalities during Scheduled Searches		Incidental Fatalities On Search Plots		Incidental Fatalities Off Search Plots		Total	
Species	**Total**	**% Comp.**	**Total**	**% Comp.**	**Total**	**% Comp.**	**Total**	**% Comp.**
hoary bat	13	33.3	0	0	0	0	13	31.7
eastern red bat	10	25.6	0	0	1	50.0	11	26.8
little brown bat	10	25.6	0	0	1	50.0	11	26.8
silver-haired bat	3	7.7	0	0	0	0	3	7.3
tri-colored bat	2	5.1	0	0	0	0	2	4.9
big brown bat	1	2.6	0	0	0	0	1	2.4
Overall Bats	**39**	**100**	**0**	**0**	**2**	**100**	**41**	**100**

Table 6.2-1e. Total number of bat casualties and the composition of casualties discovered on the 120-m x 120-m plots at the Oak Glen Wind Farm from July 15 – October 31, 2013.

	Fatalities during Scheduled Searches		Incidental Fatalities On Search Plots		Incidental Fatalities Off Search Plots		Total	
Species	**Total**	**% Comp.**	**Total**	**% Comp.**	**Total**	**% Comp.**	**Total**	**% Comp.**
little brown bat	15	53.6	0	0	0	0	15	51.7
eastern red bat	6	21.4	1	100	0	0	7	24.1
hoary bat	5	17.9	0	0	0	0	5	17.2
silver-haired bat	2	7.1	0	0	0	0	2	6.9
Overall Bats	**28**	**100**	**1**	**100**	**0**	**0**	**29**	**100**

* - Roads and Pads, not full plots were searched from September 1 - 23, 2013 due to crop spraying,

Table 6.2-1f. Total number of bat casualties and the composition of casualties discovered at roads and pads at the Oak Glen Wind Farm from July 15 – October 31, 2013.

	Fatalities during Scheduled Searches		Incidental Fatalities On Search Plots		Incidental Fatalities Off Search Plots		Total	
Species	**Total**	**% Comp.**	**Total**	**% Comp.**	**Total**	**% Comp.**	**Total**	**% Comp.**
hoary bat	5	45.5	0	0	0	0	5	45.5
eastern red bat	3	27.3	0	0	0	0	3	27.3
little brown bat	2	18.2	0	0	0	0	2	18.2
silver-haired bat	1	9.1	0	0	0	0	1	9.1
Overall Bats	**11**	**100**	**0**	**0**	**0**	**0**	**11**	**100**

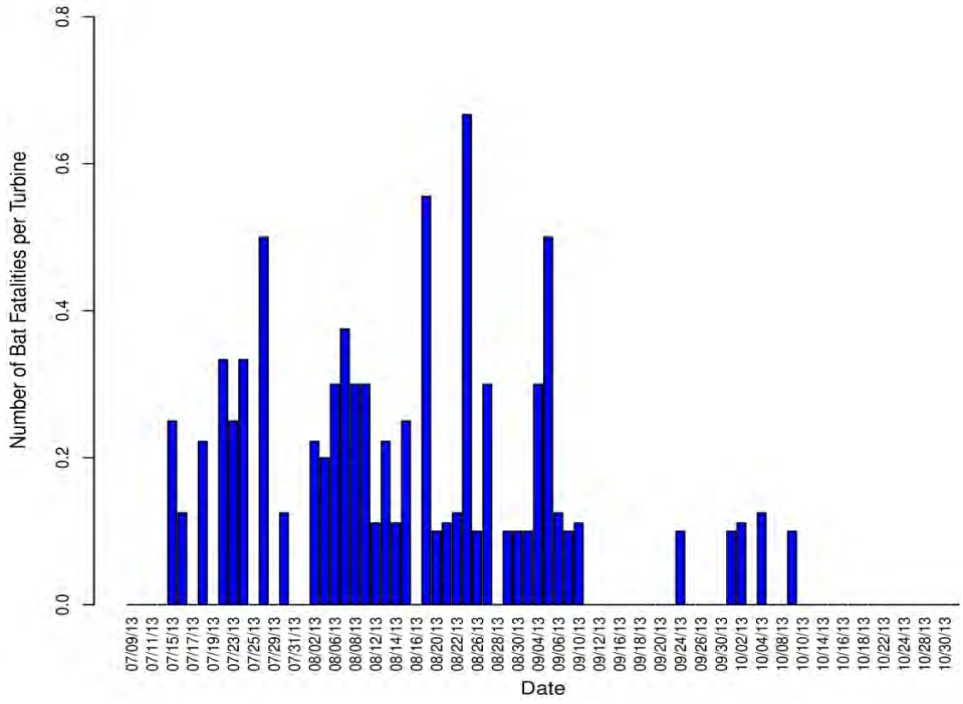


Figure 6.2-1a. Temporal distribution of bat fatalities found at 120-m x 120-m plots during the survey period July 9 to October 31, 2013, at the Big Blue Wind Farm. (Road and pad were only searched from September 1-23, 2013 due to crop spraying)

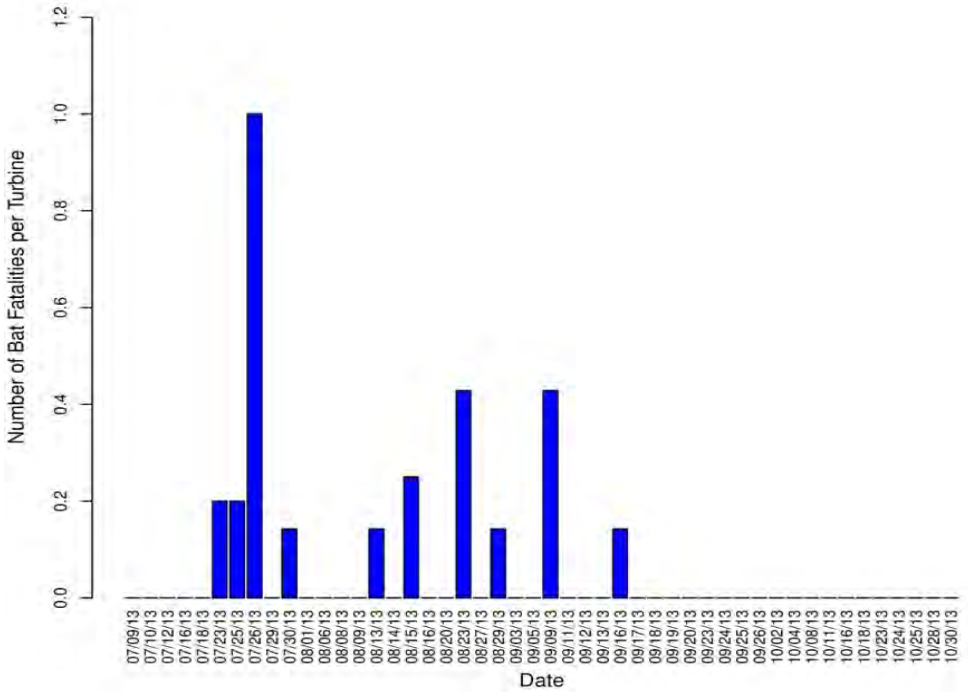


Figure 6.2-1b. Temporal distribution of bat fatalities found at roads and pads during the survey period July 9 to October 31, 2013, at the Big Blue Wind Farm.

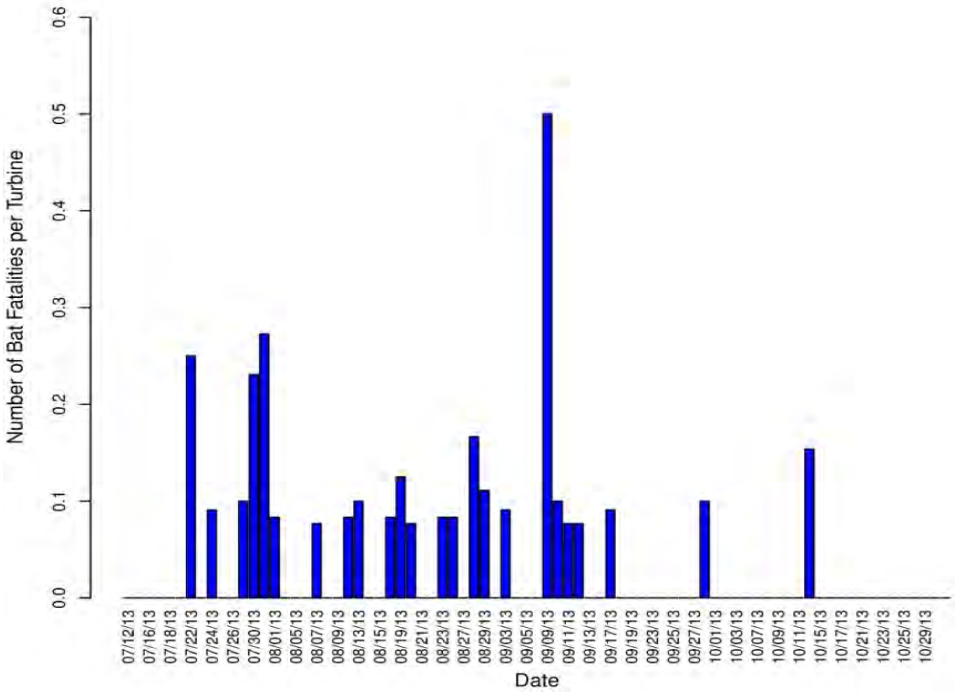


Figure 6.2-1c. Temporal distribution of bat fatalities found at 120-m x 120-m plots during the survey period July 12 to October 31, 2013, at the Grand Meadow Wind Energy Facility. (Road and pad were only searched from September 1-23, 2013 due to crop spraying)

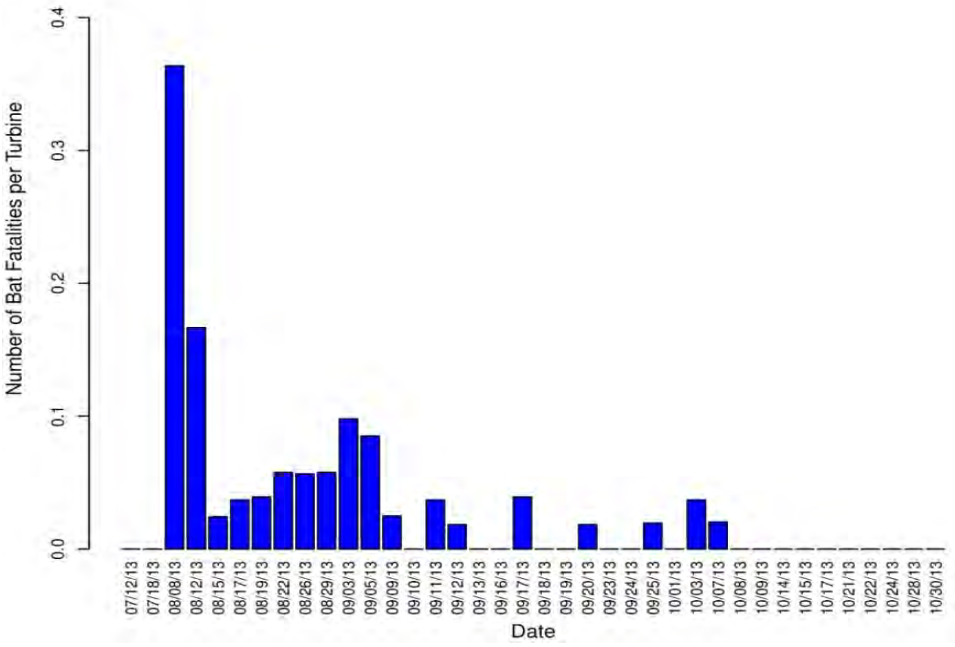


Figure 6.2-1d. Temporal distribution of bat fatalities found at roads and pads during the survey period July 12 to October 31, 2013, at the Grand Meadow Wind Farm.

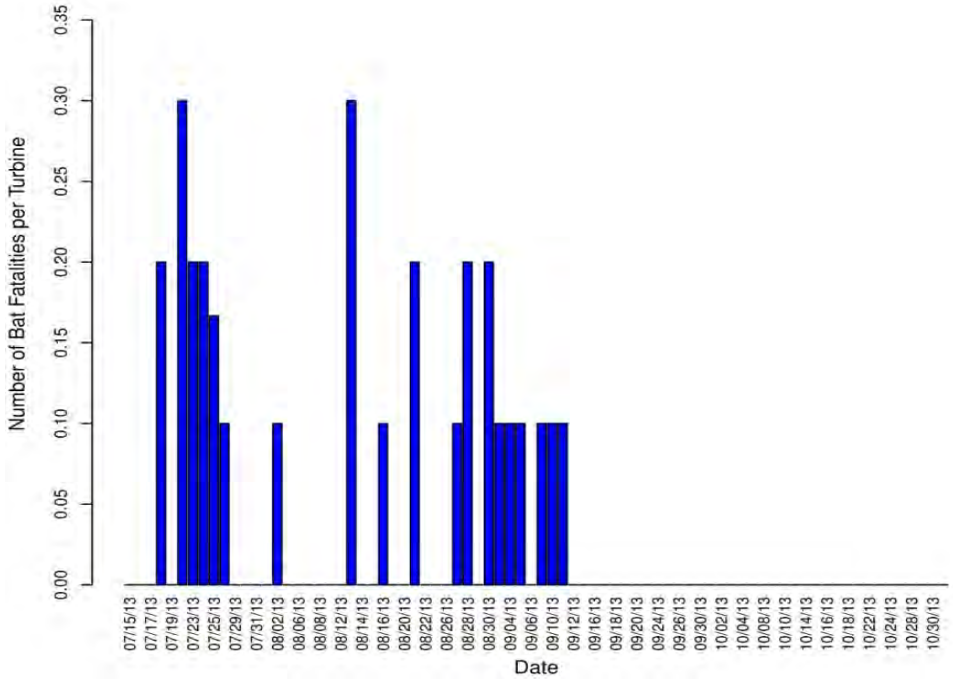


Figure 6.2-1e. Temporal distribution of bat fatalities found at 120-m x 120-m plots during the survey period July 15 to October 31, 2013, at the Oak Glen Wind Farm. (Road and pad were only searched from September 1-23, 2013 due to crop spraying)

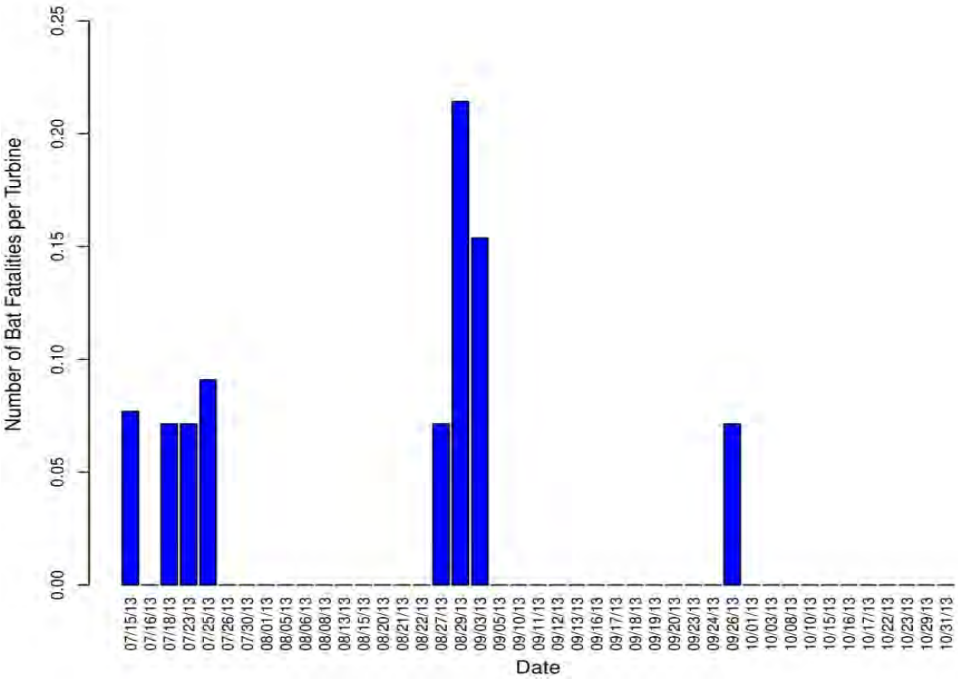


Figure 6.2-1f. Temporal distribution of bat fatalities found at roads and pads during the survey period July 15 to October 31, 2013, at the Oak Glen Wind Farm.

6.2.2.3 Distribution of Bat Fatalities: Spatial Patterns and Turbines

Bat fatalities were located at 17 of the 18 search turbines at Big Blue (Figure 6.2-2a), with an average of 5.06 bats per turbine. The majority (84.6%) of bat fatalities were found at turbines where plots were searched. Turbines 1, 3, 7, 8, 11, and 18 had the greatest number of fatalities, ranging from eight to 16 bat fatalities per turbine (Figure 6.2-2a). Approximately 60% of all fatalities were located at turbines in the western third of Big Blue (west of Highway 1; Figure 6.2-3a).

Bat fatalities were located at approximately half of all search turbines at Grand Meadow (Figure 6.2-2b), with an average of 1.06 bats per turbine. A similar number of bat fatalities were found at turbines with full plots as turbines with only roads and pads searched. Typically, one or two bat fatalities were found per turbine; however turbines 103, 106, 111, 112, 121, and 162 had four or more fatalities (Figure 6.2-2b). Bat fatalities were distributed relatively evenly throughout Grand Meadow (Figure 6.2-3b and 6.2-3c).

Bat fatalities were found at 71% of all search turbines (17 turbines) at Oak Glen (Figure 6.2-2c), with an average of 1.67 bats per turbine. The majority (72.6%) of bat fatalities were found at turbines where plots were searched versus turbines where only road and pads were surveyed. Turbines 2, 12, 18, and 23 had the greatest number of fatalities, ranging from four to seven bat fatalities per turbine (Figure 6.2-2c). The majority of bat fatalities were located east of County Road 24, with 35% of all fatalities located at turbines 18 and 23 (Figures 6.2-2c and 6.2-3d).

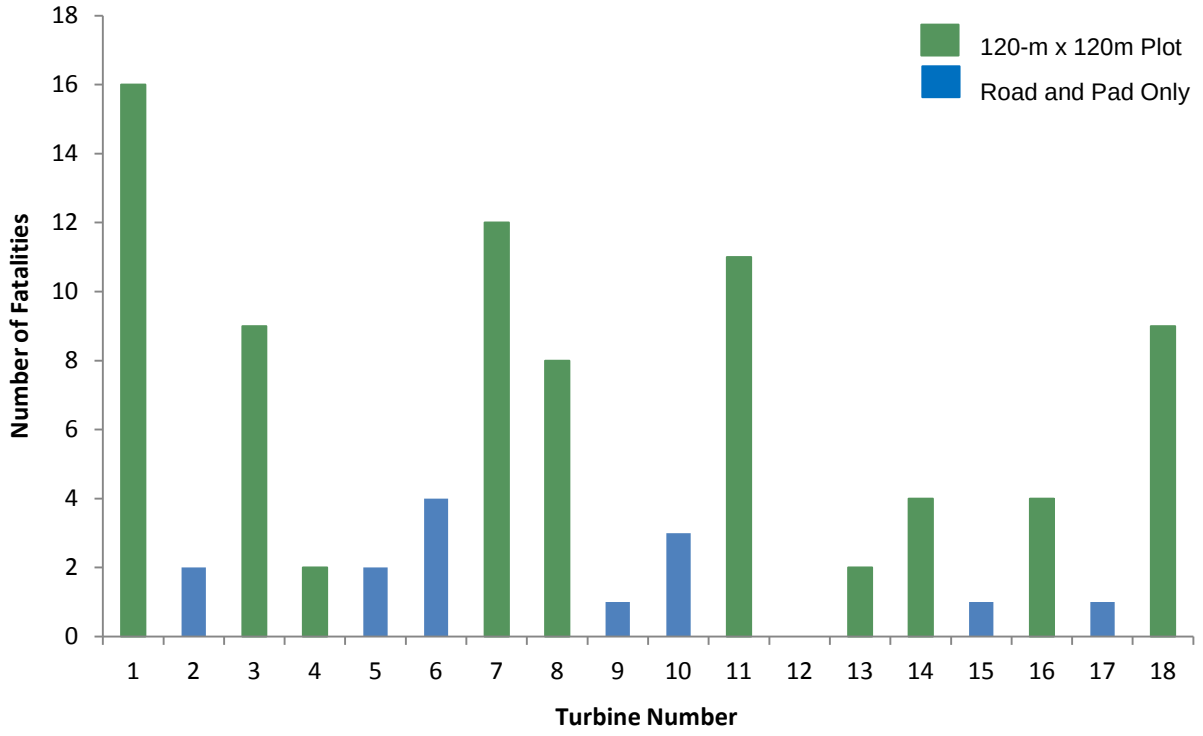


Figure 6.2-2a. Spatial distribution, by turbine location, of bat fatalities within the Big Blue Wind Farm from July 9 to October 31, 2013.

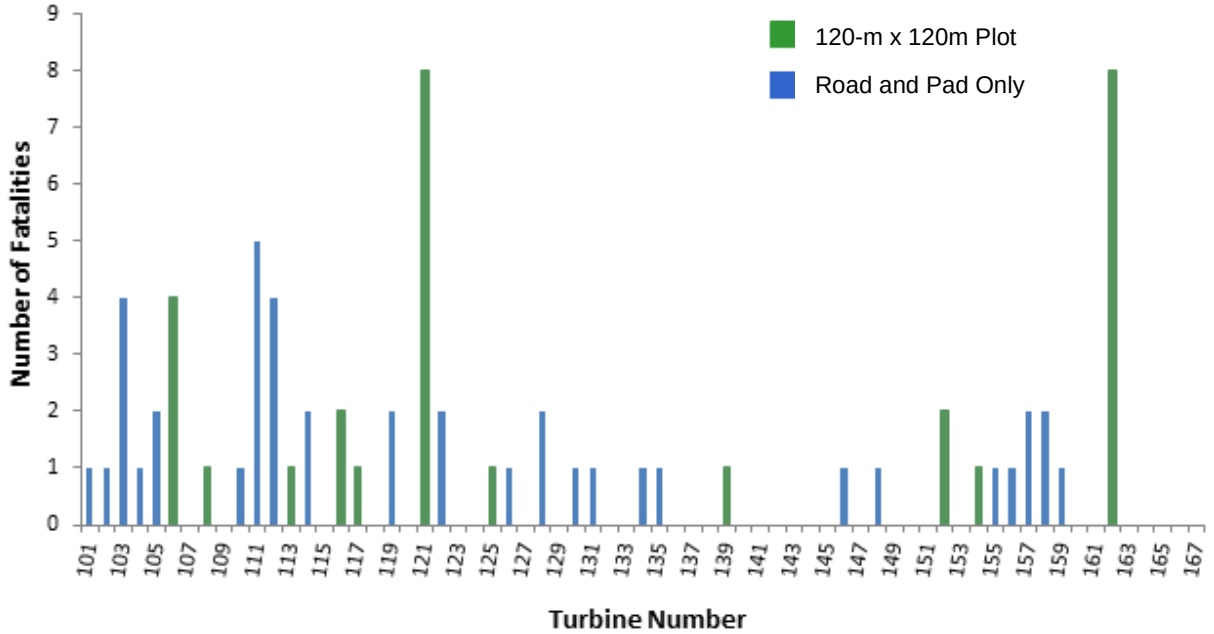


Figure 6.2-2b. Spatial distribution, by turbine location, of bat fatalities within the Grand Meadow Wind Farm from July 12 to October 31, 2013.

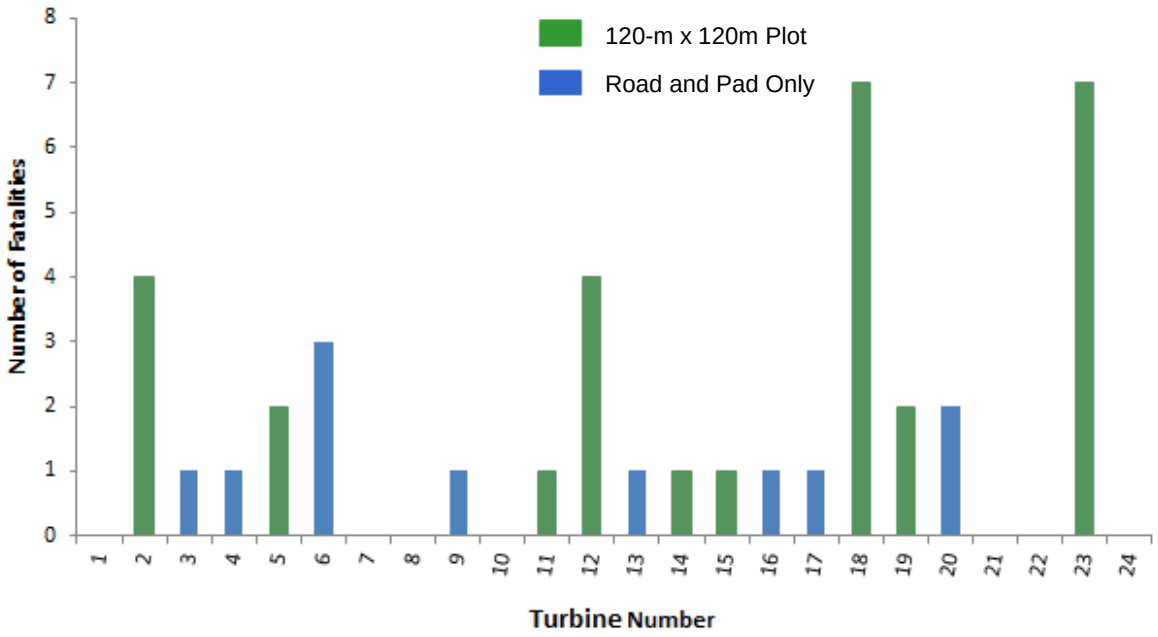


Figure 6.2-2c. Spatial distribution, by turbine location, of bat fatalities within the Oak Glen Wind Farm from July 15 to October 31, 2013.

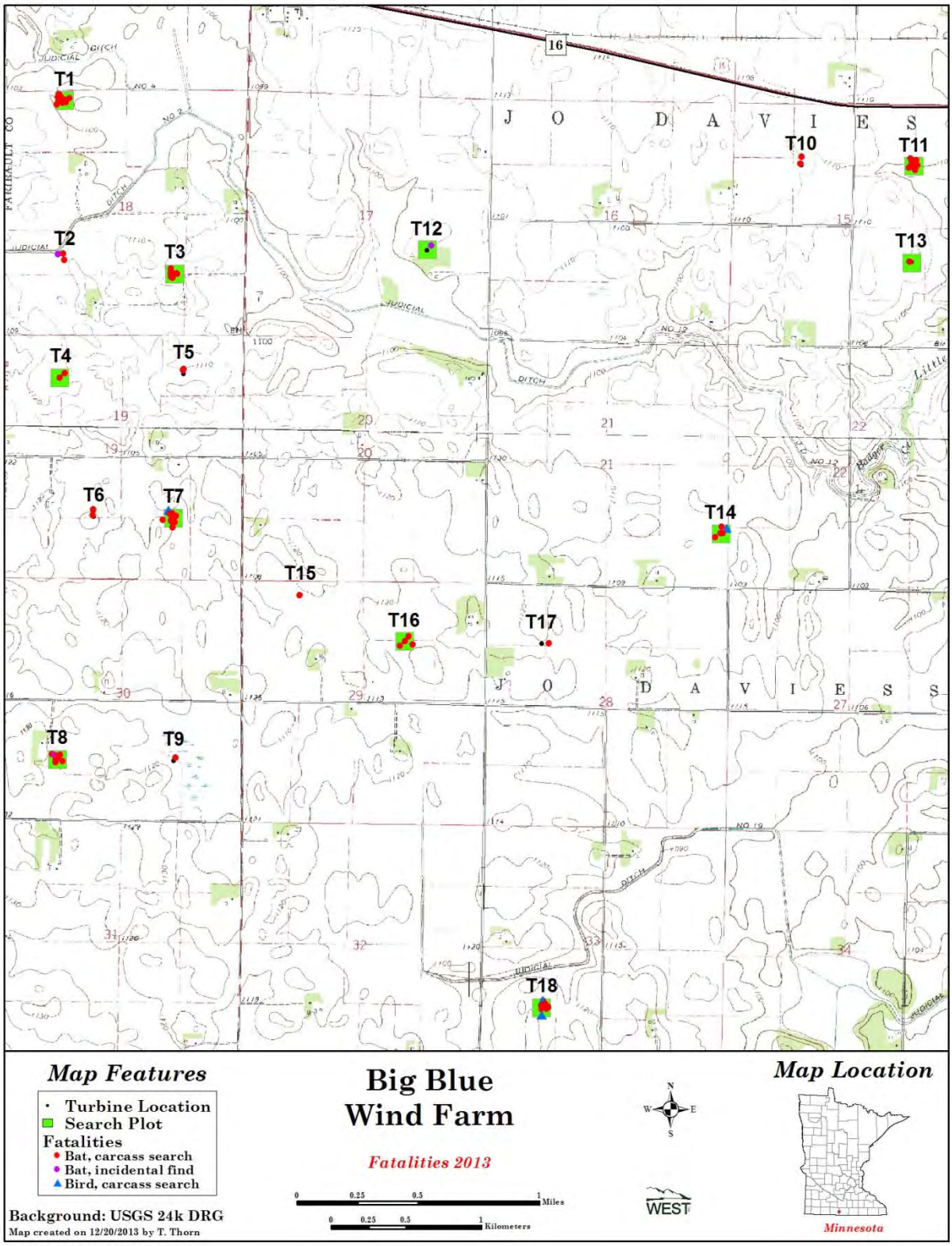


Figure 6.2-3a. Location of avian and bat fatalities within the Big Blue Wind Farm from July 9 – October 31, 2013.

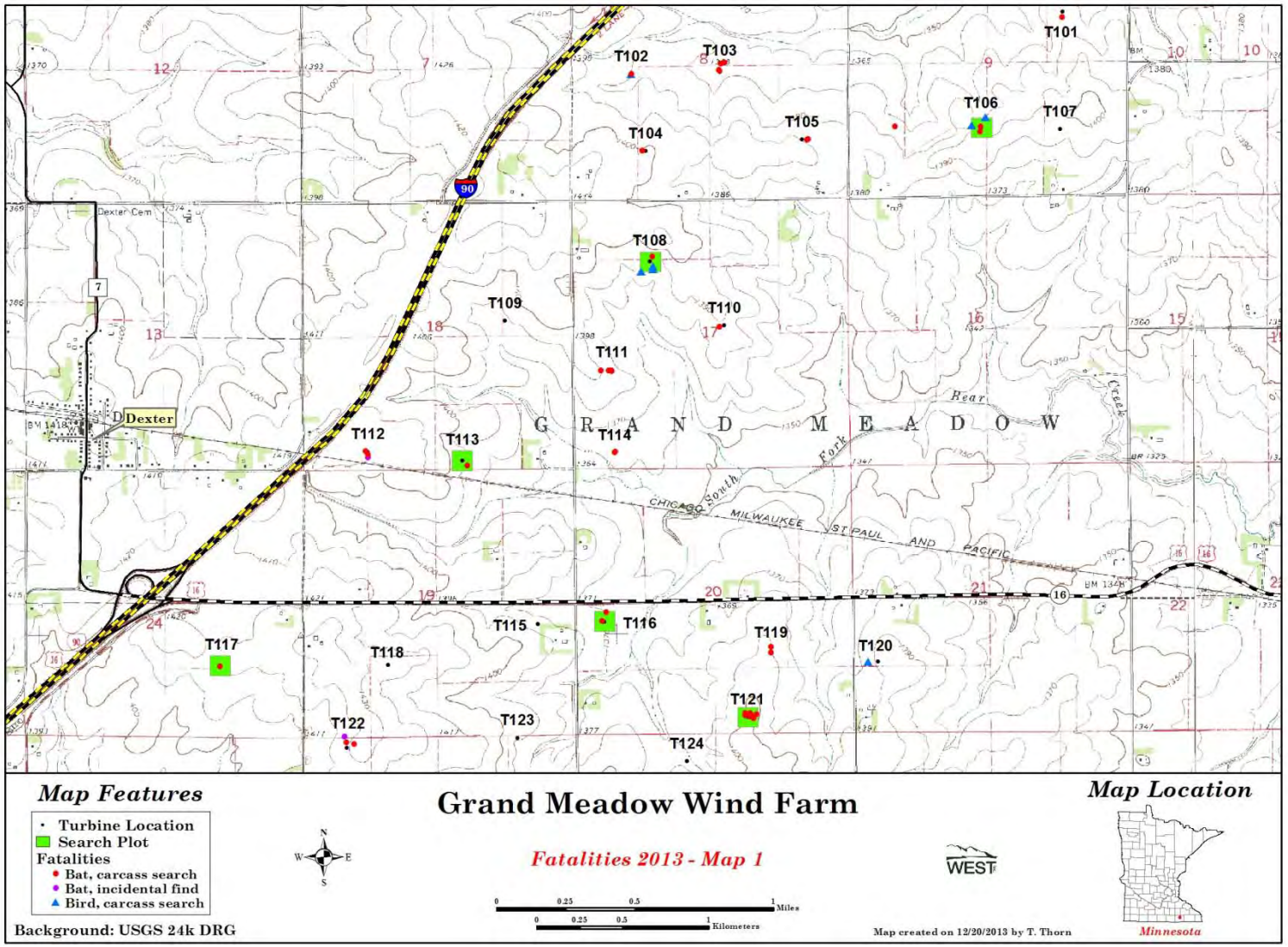


Figure 6.2-3b. Location of avian and bat fatalities within the northern half of the Grand Meadow Wind Farm from July 12 – October 31, 2013.

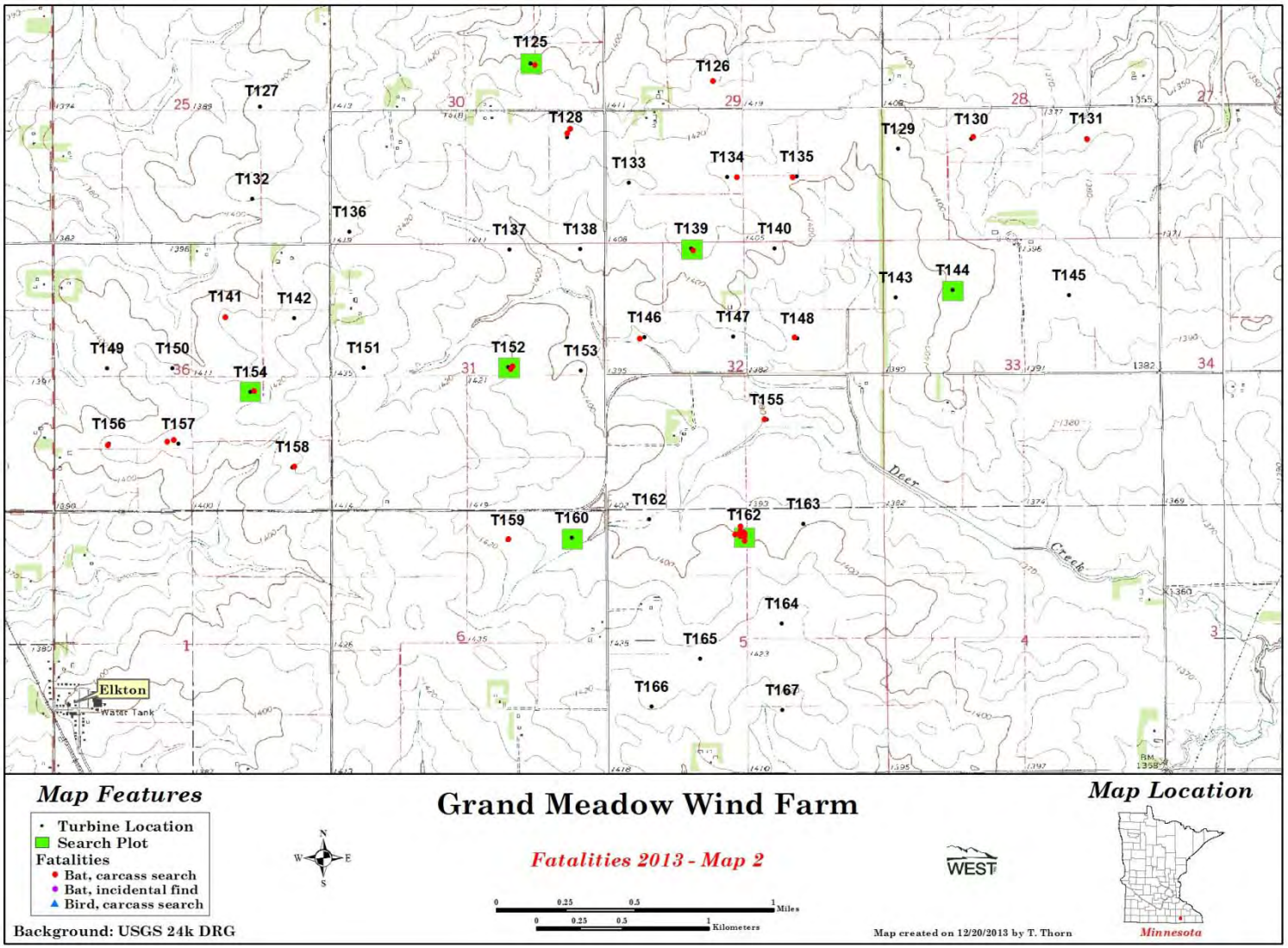


Figure 6.2-3c. Location of bat and avian fatalities within the southern half of the Grand Meadow Wind Farm from July 12 – October 31, 2013.

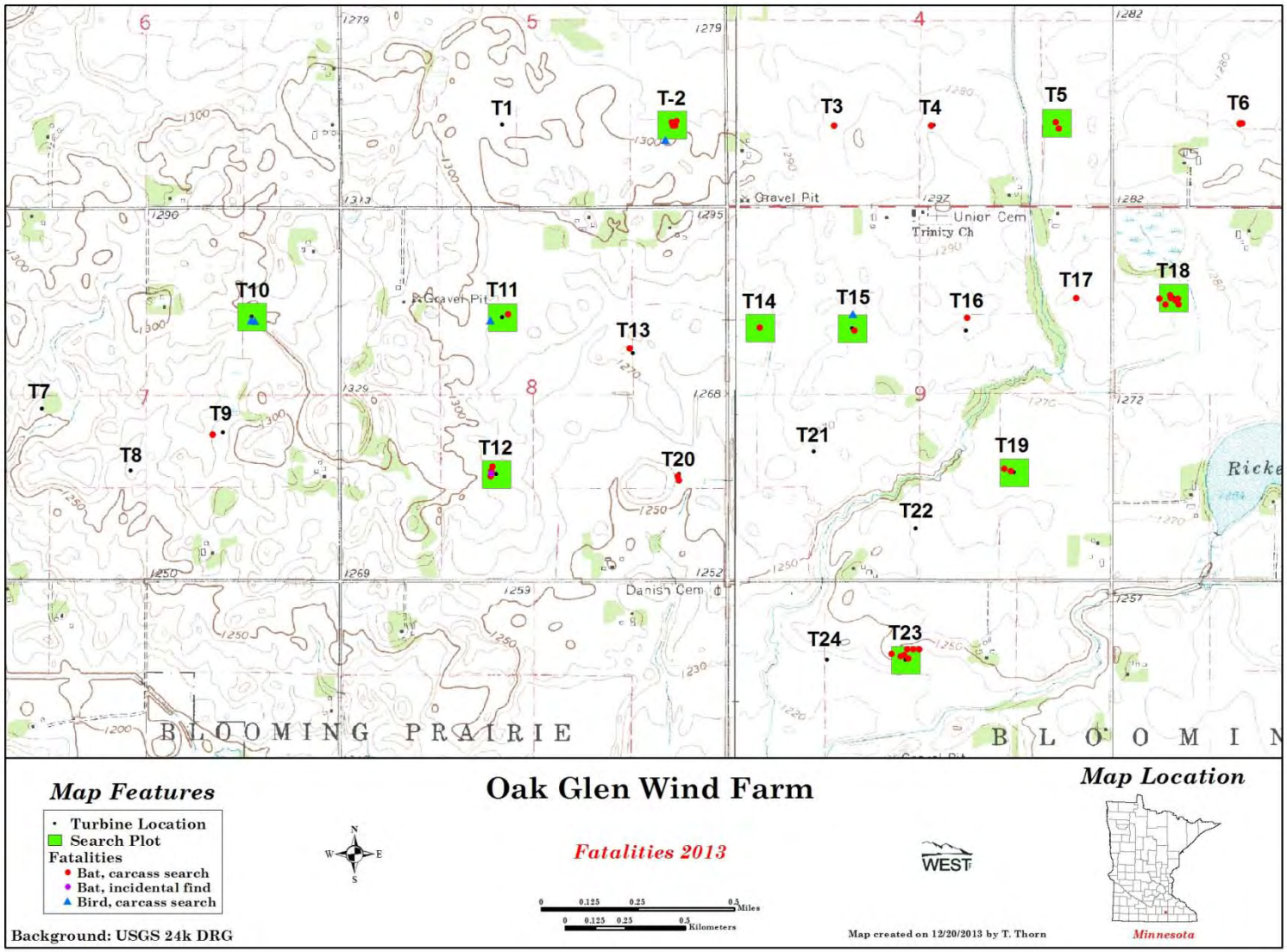


Figure 6.2-3d. Location of avian and bat fatalities within the Oak Glen Wind Farm from July 15 – October 31, 2013.

6.2.2.4 Distribution of Fatalities: Distance from Turbine

At Big Blue, Grand Meadow, and Oak Glen, regardless of search type (i.e. full plot or road and pad), the majority of all fatalities were primarily located between zero and 30 m (zero and 98.4 ft) from a turbine (Tables 6.2-2a – 6.2-2c). However, these percentages did not account for detection and scavenging bias, or the searched area, which varies as a function of distance from turbine.

Table 6.2-2a. Distribution of distances of 91 bat casualties (Plot – 77 bats; Road/Pad – 14 bats) from turbines at the Big Blue Wind Farm from July 9 – October 31, 2013.

	120-m x 120m Plots		Roads and Pads	
Distance to Turbine (m)	Total Acres Searched	% of Bat Casualties	Total Acres Searched	% of Bat Casualties
0 to 10	0.28	14.3	0.38	21.4
11 to 20	2.19	24.7	0.12	21.4
21 to 30	3.73	27.3	0.14	28.6
31 to 40	5.28	18.2	0.15	0
41 to 50	6.80	13.0	0.20	14.3
51 to 60	8.16	2.6	0.25	14.3

Table 6.2-2b. Distribution of distances of 69 bat casualties (Plot – 30 bats; Road/Pad – 39 bats) from turbines at the Grand Meadow Wind Farm from July 12 – October 31, 2013.

	120-m x 120m Plots		Roads and Pads	
Distance to Turbine (m)	Total Acres Searched	% of Bat Casualties	Total Acres Searched	% of Bat Casualties
0 to 10	0.34	20.0	2.35	41.0
11 to 20	2.76	16.7	1.04	20.5
21 to 30	4.80	40.0	0.85	17.9
31 to 40	6.81	3.3	0.94	2.6
41 to 50	8.75	6.7	1.02	5.1
51 to 60	10.82	10.0	1.09	10.3
61 to 70	6.77	3.3	0.39	2.6

Table 6.2-2c. Distribution of distances of 39 bat casualties (Plot – 28 bats; Road/Pad – 11 bats) from turbines at the Oak Glen Wind Farm from July 15 – October 31, 2013.

	120-m x 120m Plots		Roads and Pads	
Distance to Turbine (m)	Total Acres Searched	% of Bat Casualties	Total Acres Searched	% of Bat Casualties
0 to 10	0.40	20.7	0.56	63.6
11 to 20	2.14	20.7	0.20	9.1
21 to 30	3.71	24.1	0.17	9.1
31 to 40	5.28	17.2	0.21	9.1
41 to 50	6.76	3.5	0.23	9.1
51 to 60	8.15	10.3	0.25	0
61 to 70	5.03	3.5	0.09	0

6.2.2.5 Estimated Time since Death

Overall, the majority of bat casualties at Big Blue, Grand Meadow and Oak Glen were estimated to be less than 3 days old (Tables 6.2-3a – 6.2-3c). At Big Blue, most bat casualties within plots

were estimated to have been killed the night prior to searching (35.1%) or two to three days (23.4%) before the scheduled search (Table 6.2-3a). For road and pad searches at Big Blue, 71.4% of all casualties were estimated to have been killed the previous night (Table 6.2-3a). Similarly, for plot and road and pad searches at Grand Meadow, 50.0% and 41.0%, respectively, of all fatalities were estimated to have been killed last night (Table 6.2-3b). At Oak Glen, 41.4% of all fatalities found within plots were estimated to be fresh, while 63.6% of all fatalities on roads and pads were estimated to have been killed last night (Table 6.2-3c).

Table 6.2-3a. Estimated time since death of bat fatalities at the Big Blue Wind Farm from July 9 to October 31, 2013*.

	Plots		Roads and Pads	
Estimated Time Since Death*	Number of Fatalities	Percent Composition	Number of Fatalities	Percent Composition
last night	27	35.1	10	71.4
2-3 days	18	23.4	3	21.4
4-7 days	20	26.0	1	7.1
7-14 days	3	3.9	0	0
>2 weeks	8	10.4	0	0
>month	1	1.3	0	0
Unknown	0	0	0	0

* - (Road and pad were only searched from September 1-23, 2013 due to crop spraying)

Table 6.2-3b. Estimated time since death of bat fatalities at the Grand Meadow Wind Farm from July 12 to October 31, 2013.

	Plots		Roads and Pads	
Estimated Time Since Death*	Number of Fatalities	Percent Composition	Number of Fatalities	Percent Composition
last night	15	50.0	16	41.0
2-3 days	12	40.0	9	23.1
4-7 days	1	3.3	8	20.5
7-14 days	0	0	2	5.1
>2 weeks	2	6.7	1	2.6
>month	0	0	0	0
Unknown	0	0	3	7.7

* - (Road and pad were only searched from September 1-23, 2013 due to crop spraying)

Table 6.2-3a. Estimated time since death of bat fatalities at the Oak Glen Wind Farm from July 15 to October 31, 2013.

	Plots		Roads and Pads	
Estimated Time Since Death*	Number of Fatalities	Percent Composition	Number of Fatalities	Percent Composition
last night	12	41.4	7	63.6
2-3 days	10	34.5	4	36.4
4-7 days	4	13.8	0	0
7-14 days	3	10.3	0	0
>2 weeks	0	0	0	0
>month	0	0	0	0
Unknown	0	0	0	0

* - (Road and pad were only searched from September 1-23, 2013 due to crop spraying)

6.2.3 Bird Fatalities

6.2.3.1 Characteristics of Bird Fatalities

Overall, in 2013 a total of 16 bird fatalities were found during standardized carcass surveys at all three facilities combined (Tables 6.2-4a – 6.2-4d). Grand Meadow, Oak Glen, and Big Blue had seven, five, and four bird fatalities, respectively (Big Blue: Plot – 4 bird fatalities; Road/Pad – 0 bird fatalities; Grand Meadow Plot – 2 bird fatalities; Road/Pad – 5 bird fatalities; Oak Glen Plot – 0 bird fatalities; Road/Pad – 5 bird fatalities). Brown creeper (*Certhia americana*) and golden-crowned kinglet (*Regulus satrapa*) each had three fatalities (Tables 6.2-4a – 6.2-4d). No bird fatalities were found incidentally on or off of search plots. No bird species of special concern were found. The number, location, other characteristics of the bird fatalities, and the fatality estimates adjusted for searcher efficiency and carcass removal biases are discussed below.

Table 6.2-4a. Total number of bird casualties and the composition of casualties discovered on the 120-m x 120-m plots at the Big Blue Wind Farm from July 9 – October 31, 2013.

	Fatalities during Scheduled Searches		Incidental Fatalities On Search Plots		Incidental Fatalities Off Search Plots		Total	
Species	**Total**	**% Comp.**	**Total**	**% Comp.**	**Total**	**% Comp.**	**Total**	**% Comp.**
common grackle	1	25.0	0	0	0	0	1	25.0
European starling	1	25.0	0	0	0	0	1	25.0
golden-crowned kinglet	1	25.0	0	0	0	0	1	25.0
sedge wren	1	25.0	0	0	0	0	1	25.0
Overall Birds	**4**	**100.0**	**0**	**0**	**0**	**0**	**4**	**100.0**

Table 6.2-4b. Total number of bird casualties and the composition of casualties discovered on the 120-m x 120-m plots at the Grand Meadow Wind Farm from July 12 – October 31, 2013.

	Fatalities during Scheduled Searches		Incidental Fatalities On Search Plots		Incidental Fatalities Off Search Plots		Total	
Species	**Total**	**% Comp.**	**Total**	**% Comp.**	**Total**	**% Comp.**	**Total**	**% Comp.**
brown creeper	2	40.0	0	0	0	0	2	40.0
American goldfinch	1	20.0	0	0	0	0	1	20.0
golden-crowned kinglet	1	20.0	0	0	0	0	1	20.0
unidentified shorebird	1	20.0	0	0	0	0	1	20.0
Overall Birds	**5**	**100**	**0**	**0**	**0**	**0**	**5**	**100**

Table 6.2-4c. Total number of bird casualties and the composition of casualties discovered on the roads and pads plots at the Grand Meadow Wind Farm from July 12 – October 31, 2013.

	Fatalities during Scheduled Searches		Incidental Fatalities On Search Plots		Incidental Fatalities Off Search Plots		Total	
Species	**Total**	**% Comp.**	**Total**	**% Comp.**	**Total**	**% Comp.**	**Total**	**% Comp.**
brown creeper	1	50.0	0	0	0	0	1	50.0
dickcissel	1	50.0	0	0	0	0	1	50.0
Overall Birds	**2**	**100**	**0**	**0**	**0**	**0**	**2**	**100**

Table 6.2-4d. Total number of bird casualties and the composition of casualties discovered on the 120-m x 120-m plots at the Oak Glen Wind Farm from July 15 – October 31, 2013.

	Fatalities during Scheduled Searches		Incidental Fatalities On Search Plots		Incidental Fatalities Off Search Plots		Total	
Species	**Total**	**% Comp.**	**Total**	**% Comp.**	**Total**	**% Comp.**	**Total**	**% Comp.**
American redstart	1	20.0	0	0	0	0	1	20.0
field sparrow	1	20.0	0	0	0	0	1	20.0
golden-crowned kinglet	2	40.0	0	0	0	0	2	40.0
unidentified blackbird	1	20.0	0	0	0	0	1	20.0
Overall Birds	**5**	**100**	**0**	**0**	**0**	**0**	**5**	**100**

6.2.3.2 Distribution of Bird Fatalities: Temporal Patterns

The majority of all bird fatalities at Big Blue, Grand Meadow, and Oak Glen were primarily found in the fall, particularly October 2013 (Figure 6.2-4).

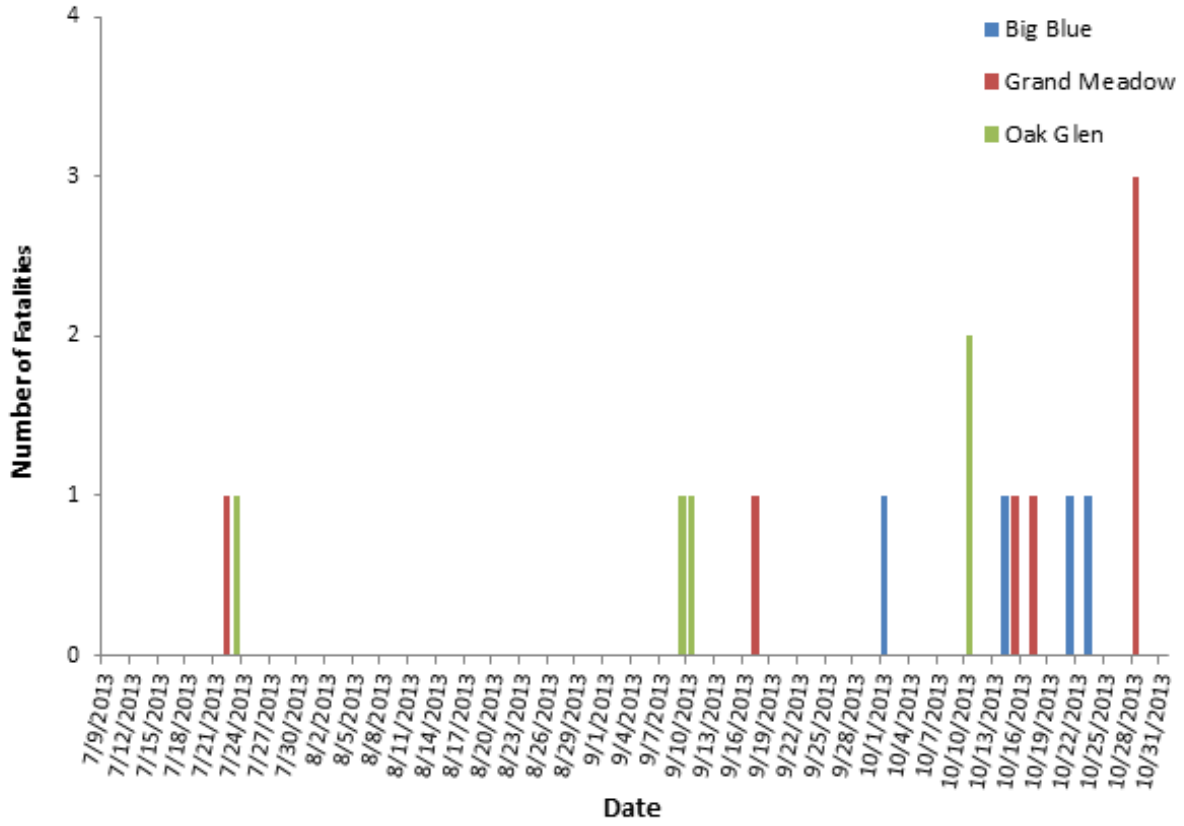


Figure 6.2-4. Temporal distribution of bat fatalities found during the survey period July 9 to October 31, 2013, at the Big Blue, Grand Meadow, and Oak Glen wind energy facilities.

6.2.3.3 Distribution of Bird Fatalities: Spatial Patterns and Turbines

Bird fatalities were located at three turbines (7, 14, and 18; Figure 6.2-3a) at Big Blue, averaging 0.22 bird fatalities per turbine. Two fatalities were found at turbine 18. Fatalities were scattered throughout Big Blue (Figure 6.2-3a).

Bird fatalities were located at five turbines (102, 106, 108, 120, and 125; Figure 6.2-3b) at Grand Meadow, averaging 0.10 birds per turbine. Turbines 106 and 108 each had two fatalities. Fatalities were primarily located in the northern half of Grand Meadow (Figures 6.2-3b and 6.2-3c).

Bird fatalities were located at four turbines (2, 10, 11, and 15; Figure 6.2-3d) at Oak Glen, averaging 0.21 birds per turbine. Turbine 10 had two fatalities. Fatalities were primarily located in the northern half of Oak Glen (Figure 6.2-3d).

6.2.3.4 Distribution of Bird Fatalities: Distance from Turbine

At Big Blue, Grand Meadow, and Oak Glen, the majority of all bird fatalities were primarily located between zero and 50 m (zero and 165 ft) from the turbine (Table 6.2-5). However, these percentages did not account for detection and scavenging bias, or the searched area, which varies as a function of distance from turbine.

Table 6.2-5. Distribution of distances of bird casualties from turbines at the Big Blue, Grand Meadow, and Oak Glen wind energy facilities from July 9 – October 31, 2013.

	Big Blue	Grand Meadow		Oak Glen
Distance to Turbine (m)	% of Bird Casualties on Plots	% of Bird Casualties on Plots	% of Bird Casualties on Roads and Pads	% of Bird Casualties on Plots
0 to 10	0	14.3	50.0	20.0
11 to 20	0	0	0	20.0
21 to 30	0	14.3	0	0
31 to 40	0	14.3	0	0
41 to 50	75.0	14.3	50.0	40.0
51 to 60	25.0	28.6	0	0
61 to 70	0	0	0	0
71 to 80	0	14.3	0	20.0

6.2.3.5 Estimated Time since Death

Most bird casualties at Big Blue and Oak Glen were estimated to have been killed the previous night (75.0% and 80.0%, respectively; Table 6.2-6). Comparatively at Grand Meadow, the majority of bird fatalities were estimated to be within two to three days before a scheduled search (57.1%; Table 6.2-6).

Table 6.2-6. Estimated time since death of bird fatalities at the Big Blue, Grand Meadow, and Oak Glen wind energy facilities from July 9 to October 31, 2013.

	Big Blue		Grand Meadow		Oak Glen	
Estimated Time Since Death*	Number of Fatalities	Percent Composition	Number of Fatalities	Percent Composition	Number of Fatalities	Percent Composition
last night	3	75.0	1	14.3	4	80.0
2-3 days	1	25.0	4	57.1	0	0
4-7 days	0	0	2	28.6	1	20.0
7-14 days	0	0	0	0	0	0
>2 weeks	0	0	0	0	0	0
>month	0	0	0	0	0	0
Unknown	0	0	0	0	0	0

6.3 Searcher Efficiency Trials

6.3.1 Shoenfeld and Huso

Overall single-search searcher efficiency at Big Blue for bat carcasses was estimated to be 43.8%, for small bird carcasses it was estimated to be 33.3% for all trials, and 77.8% for large birds (Table 6.3-1a). Results were similar for Grand Meadow and Oak Glen for bats, with efficiency rates of 35.4% and 23.1%, respectively (Tables 6.3-1b and 6.3-1c). Efficiency rates for large birds were slightly lower, with a rate of 50.0% at both Grand Meadow and Oak Glen (Tables 6.3-1b and 6.3-1c). Overall searcher efficiency rate for small birds at Grand Meadow and Oak Glen were 30.0% and 45.5%, respectively (Tables 6.3-1b and 6.3-1c).

6.3.2 Empirical Pi

The overall rate for carcass detection and availability for bat carcasses at Big Blue, Grand Meadows, and Oak Glen was estimated to be 47.1%, 50.0%, and 59.1%, respectively (Tables 6.3-3a – 6.3-3c). Estimated rates for small birds ranged from 50.0% to 70.0%. Trials conducted for large birds resulted in an estimated probability of available and detected of 89.9%, 83.3%, and 77.8% for Big Blue, Grand Meadows, and Oak Glen, respectively.

The carcass detection and availability rates for Big Blue and Oak Glen are biased as carcasses were only placed on the same day as carcass searches, which does not appropriately capture removal time.

Table 6.3-1a. Searcher efficiency results for the Shoenfeld and Huso estimators at the Big Blue Wind Farm as a function of date and size class from July 9 – October 31, 2013.

	Mice				Large Birds				Small Birds			
Date	Placed	Available 1st Search	Found 1st Search	Percent Found	Placed	Available 1st Search	Found 1st Search	Percent Found	Placed	Available 1st Search	Found 1st Search	Percent Found
7/16/2013	5	1	1	100.0	2	2	1	50.0	3	3	2	66.7
8/6/2013	6	5	1	20.0	2	2	2	100.0	3	3	1	33.3
8/27/2013	5	5	2	40.0	3	3	3	100.0	2	2	1	50.0
9/17/2013	6	5	3	60.0	2	2	1	50.0	5	4	0	0.0
Overall	22	16	7	43.8	9	9	7	77.8	13	12	4	33.3

Table 6.3-1b. Searcher efficiency results for the Shoenfeld and Huso estimators at the Grand Meadow Wind Farm as a function of date and size class from July 12 – October 31, 2013.

	Mice				Large Birds				Small Birds			
Date	Placed	Available 1st Search	Found 1st Search	Percent Found	Placed	Available 1st Search	Found 1st Search	Percent Found	Placed	Available 1st Search	Found 1st Search	Percent Found
7/29/2013	5	5	3	60.0	3	3	2	66.7	2	1	0	0
8/19/2013	5	5	3	60.0	2	2	1	50.0	3	3	3	100.0
9/12/2013	5	5	1	20.0	3	3	1	33.3	2	2	0	0
9/30/2013	3	2	1	50.0	1	1	0	0.0	2	2	0	0
10/21/2013	5	5	0	0	3	3	2	66.7	2	2	0	0
Overall	23	22	8	36.4	12	12	6	50.0	11	10	3	30.0

Table 6.3-1c. Searcher efficiency results for the Shoenfeld and Huso estimators at the Oak Glen Wind Farm as a function of date and size class from July 12 – October 31, 2013.

	Mice				Large Birds				Small Birds			
Date	Placed	Available 1st Search	Found 1st Search	Percent Found	Placed	Available 1st Search	Found 1st Search	Percent Found	Placed	Available 1st Search	Found 1st Search	Percent Found
7/23/2013	5	4	0	0.0	4	4	2	50.0	1	1	0	0.0
8/13/2013	5	5	2	40.0	2	2	0	0.0	2	2	1	50.0
9/3/2013	6	6	1	16.7	3	3	2	66.7	2	2	1	50.0
9/24/2013	5	5	0	0.0	2	1	1	100.0	3	3	1	33.3
10/15/2013	6	6	3	50.0	0	0	0	0	3	3	2	66.7
Overall	27	26	6	23.1	11	10	5	50.0	11	11	5	45.5

Table 6.3-2a. Searcher efficiency results for the Empirical Pi estimator at the Big Blue Wind Farm as a function of date and size class from July 9 – October 31, 2013.

	Mice			Large Birds			Small Birds		
Date	Placed	Found Ever	Percent Found	Placed	Found Ever	Percent Found	Placed	Found Ever	Percent Found
7/16/2013	2	1	50.0	2	2	100.0	2	1	50.0
8/6/2013	6	2	33.3	2	2	100.0	2	1	50.0
8/27/2013	4	2	50.0	3	3	100.0	3	2	66.7
9/17/2013	5	3	60.0	2	1	50.0	1	0	0.0
Overall	17	8	47.1	9	8	88.9	8	4	50.0

Table 6.3-2b. Searcher efficiency results for the Empirical Pi estimator at the Grand Meadow Wind Farm as a function of date and size class from July 12 – October 31, 2013.

	Mice			Large Birds			Small Birds		
Date	Placed	Found Ever	Percent Found	Placed	Found Ever	Percent Found	Placed	Found Ever	Percent Found
7/29/2013	4	2	50.0	3	3	100.0	2	0	0.0
8/19/2013	4	3	75.0	2	2	100.0	3	3	100.0
9/17/2013	4	2	50.0	3	1	33.3	2	0	0.0
9/30/2013	3	1	33.3	1	1	100.0	2	0	0.0
10/21/2013	3	1	33.3	3	3	100.0	2	2	100.0
Overall	18	9	50.0	12	10	83.3	11	5	45.5

Table 6.3-2c. Searcher efficiency results for the Empirical Pi estimator at the Oak Glen Wind Farm as a function of date and size class from July 15 – October 31, 2013.

	Mice			Large Birds			Small Birds		
Date	Placed	Found Ever	Percent Found	Placed	Found Ever	Percent Found	Placed	Found Ever	Percent Found
7/23/2013	5	1	20.0	4	3	75.0	1	1	100.0
8/13/2013	5	4	80.0	2	2	100.0	2	0	0
9/3/2013	6	4	66.7	3	2	66.7	3	3	100.0
9/24/2013	3	1	33.3	0	0	0	2	2	100.0
10/15/2013	3	3	100.0	0	0	0	2	1	50.0
Overall	22	13	59.1	9	7	77.8	10	7	70.0

6.4 Carcass Removal Trials

Overall, a total of 280 carcasses were dropped between Big Blue, Grand Meadow, and Oak Glen. By Day 4, approximately 80% of the mouse carcasses remained and 15% remained by Day 10 at Big Blue (Figure 6.4-1a). Similarly, at Grand Meadow approximately 60% of mice remained by Day 4 and 15% remained by Day 10 (Figure 6.4-1b), and 80% of mice remained by Day 4 and 20% by Day 10 at Oak Glen (Figure 6.4-1c). Small birds followed a similar trend as mice for Big Blue, Grand Meadow, and Oak Glen, with approximately 20% of small birds remaining by Day 10 at all three facilities (Figures 6.4-1a – 6.4-1c). The removal of large birds at Big Blue, Grand Meadow, and Oak Glen followed a similar removal pattern, with approximately 45% of all large bird carcasses remaining by Day 10 (Figure 6.4-1a and 6.4-1c).

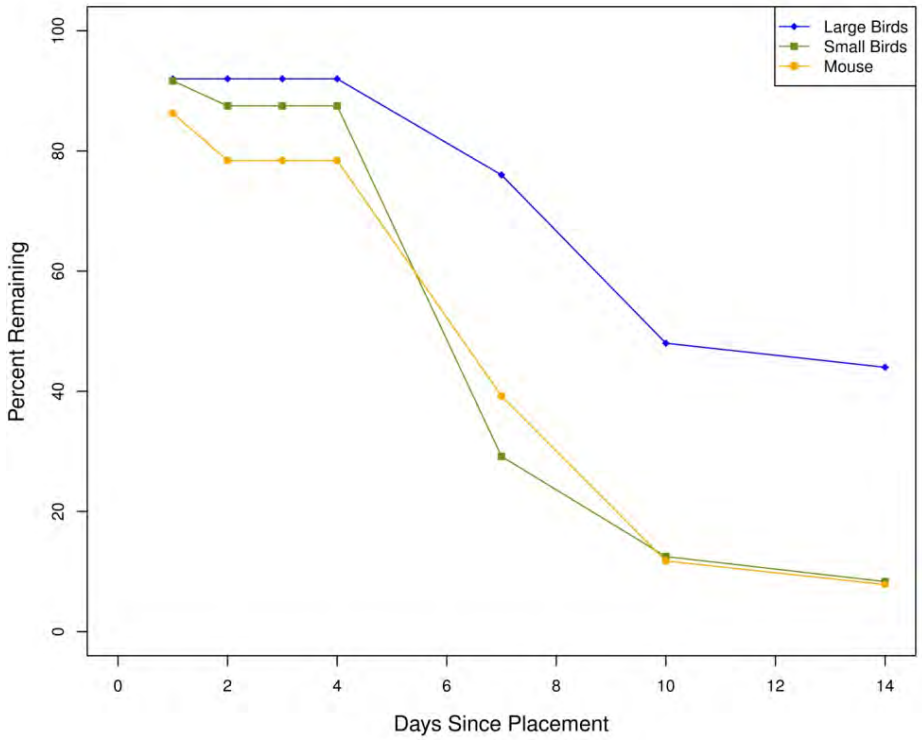


Figure 6.4-1a. Scavenger removal rates for bats and for large and small birds within the Big Blue Wind Farm from July 9 – October 31, 2013.

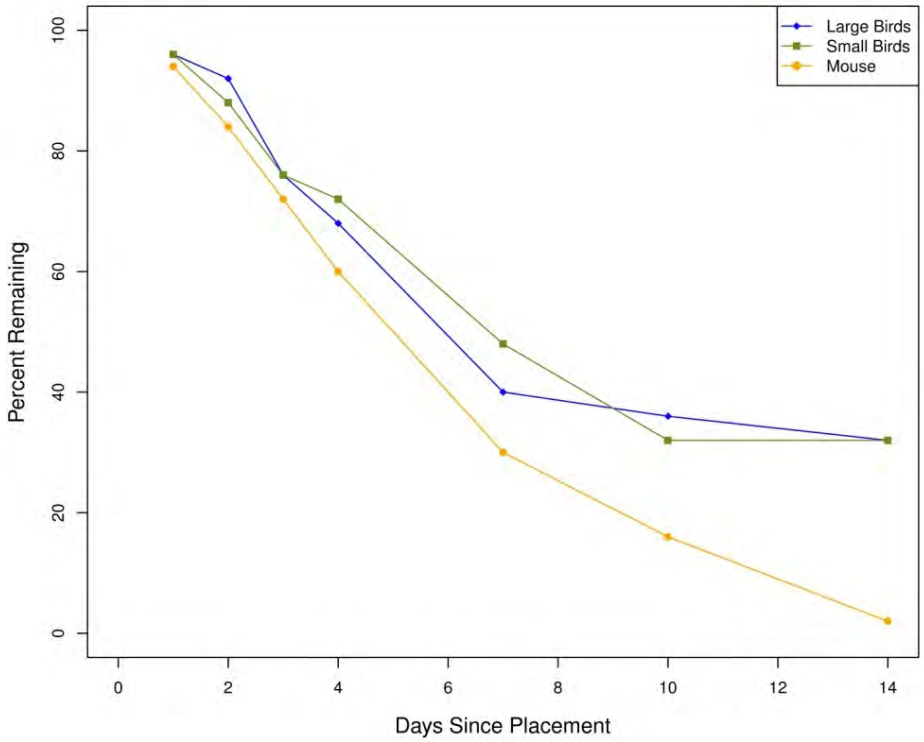


Figure 6.4-1b. Scavenger removal rates for bats and for large and small birds within the Grand Meadow Wind Farm from July 12 – October 31, 2013.

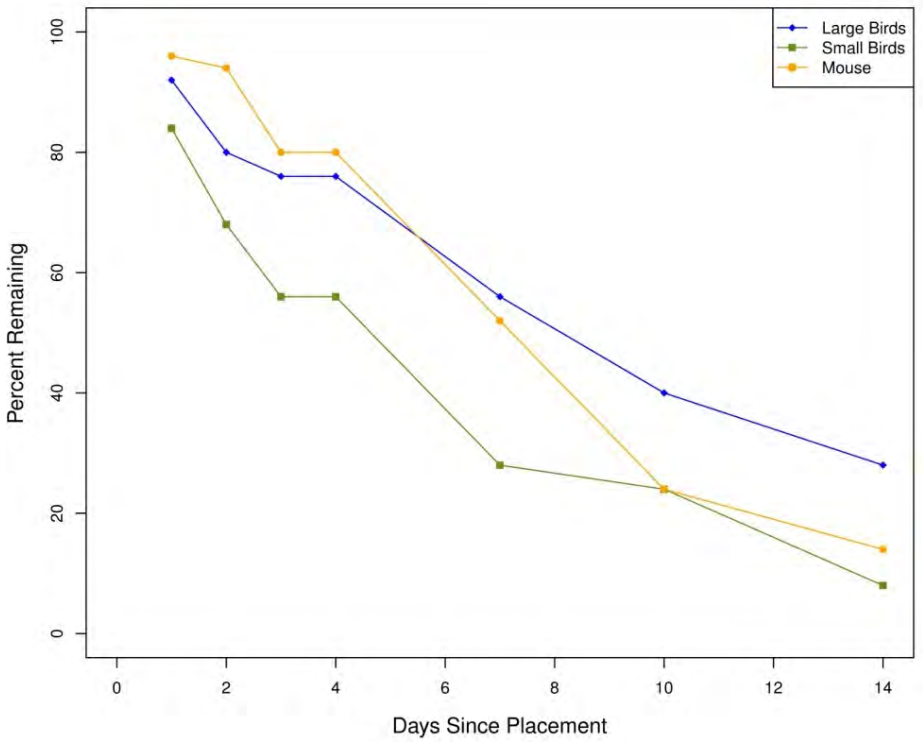


Figure 6.4-1c. Scavenger removal rates for bats and for large and small birds within the Oak Glen Wind Farm from July 15 – October 31, 2013.

The average probability of a carcass persisting in the interval used in the Huso (2011) estimator was estimated by fitting exponential, Weibull, log-normal, and log-logistic distributions and selecting the best distribution based on AICc. At Big Blue, Grand Meadow, and Oak Glen the Weibull distribution was used with a covariate for size to estimate the average probability of a carcass persisting in the interval (Table 6.4-1) as it had the lowest AICc value among the distributions.

Table 6.4-1. AICc values from models to determine the best distribution to use for the average probability of a carcass persisting in the interval for the Huso (2011) estimator.

	Facility*		
Distribution	**Big Blue**	**Grand Meadows**	**Oak Glen**
Weibull	456.02	481.33	445.82
exponential	460.86	486.48	447.82
log-logistic	467.40	483.51	449.32
log-normal	474.68	483.73	451.05

*AICc values should be compared between distributions within a facility (i.e. AICc values should not be compared between facilities).

6.5 Adjusted Fatality Estimates

Fatality estimates, standard errors, and confidence intervals (CI) were calculated for bats and birds at the Big Blue, Grand Meadow, and Oak Glen wind energy facilities (Appendices D, E, and F, respectively). Three estimators were used to calculate fatality estimates for plots, including Shoenfeld, Huso, and Empirical Pi. In addition to fatality estimates for plots, estimates were calculated for roads and pads at Grand Meadow. At Big Blue and Oak Glen, the number of road and pad searches was not sufficient to develop an independent estimate of fatality rate. Fatality estimates were adjusted based on the corrections for carcass removal, observer detection bias, and the proportion of the plot searched.

6.5.1 Bats

At Big Blue, the overall adjusted estimated number of bat fatalities for plots was 12.67 (CI: 9.55-18.22) bat fatalities per turbine per year or 6.33 bats per MW per year when using Shoenfeld estimates (Table 6.5-1a). When using Huso, estimates were lower with 9.91 (CI*:* 5.73, 20.09) bat fatalities per turbine per year or 4.96 bats per MW per year (Table 6.5-1a). The overall adjusted estimated number of bat fatalities for plots was 19.01 (CI*:* 12.25, 35.28) bat fatalities per turbine per year or 9.50 bats per MW per year when using Empirical Pi estimates (Table 6.5-1a).

Using the Shoenfeld estimator, the adjusted fatality estimate for plots was 4.66 (CI*:* 2.73, 8.03) bat fatalities per turbine per year or 3.11 bats per MW per year at Grand Meadow (Table 6.5-1b). Similarly, the overall adjusted estimated number of bat fatalities for plots was 5.52 (CI*:* 2.86, 10.03) bat fatalities per turbine per year or 3.68 bats per MW per year when using Empirical Pi estimates (Table 6.5-1b). Adjusted fatality estimates with Huso were higher, with 5.84 (CI*:* 2.98, 12.25) bat fatalities per turbine per year or 3.89 bats per MW per year (Table 6.5-1b). Fatality estimates for roads and pads at the Grand Meadow facility were calculated for the fall season only using the Shoenfeld estimator. The adjusted number of bat fatalities for fall road and pad searches at Grand Meadow was 21.48 (CI*:* 10.37, 47.22) bat fatalities per turbine per year or 14.32 bats per MW per year.

Fatality estimates at Oak Glen were lower than Big Blue and similar to estimates at Grand Meadow. The adjusted estimated number of bat fatalities for plots was 5.56 (CI*:* 3.59, 9.61) bat fatalities per turbine per year or 3.09 bats per MW per year when using Shoenfeld estimates at Oak Glen (Table 6.5-1c). Similarly, the overall adjusted estimated number of bat fatalities for plots was 5.66 (CI*:* 3.47, 9.18) bat fatalities per turbine per year or 3.15 bats per MW per year when using Empirical Pi estimates (Table 6.5-1c). When using Huso, estimates were higher with 7.71 (CI*:* 3.46, 19.61) bat fatalities per turbine per year or 4.28 bats per MW per year (Table 6.5-1c).

The estimated average probability a bat casualty would remain until a scheduled search and be found at Big Blue was 0.44 (CI 0.25 - 0.62) for the summer and fall seasons, with respect to Shoenfeld estimates (Appendix D). Probabilities using the Empirical Pi were similar to Shoenfeld, with a probability of 0.47 (CI: 0.24 - 0.71). A probability of 0.89 (CI*:* 0.86 - 0.92) for the summer and fall seasons was calculated using Huso (Appendix D). For Grand Meadow, the

estimated average probability a bat casualty would remain until a scheduled search and be found was 0.59 (CI 0.41 - 0.71) for the summer and fall seasons, with respect to Shoenfeld estimates (Appendix E). Probabilities using Empirical Pi were similar to Shoenfeld, with a probability of 0.50 (CI: 0.33 - 0.72). The estimated average probability a bat casualty would remain until a scheduled search and be found at Oak Glen ranged from 0.60 (CI 0.37 - 0.73) using the Shoenfeld estimates to 0.86 (CI: 0.73 - 0.93) using Huso estimates for the summer and fall seasons (Appendix F).

Table 6.5-1a. Adjusted bat fatality estimates using the Shoenfeld, Huso, and Empirical Pi estimators for the Big Blue Wind Farm for studies conducted from July 9 – October 31, 2013. For more details concerning correction factors and confidence intervals, refer to Appendices D, E, and F.

	Shoenfeld Estimator	Huso Estimator	Empirical Pi Estimator
	Adjusted Fatality Estimate Full Plots	Adjusted Fatality Estimate Full Plots	Adjusted Fatality Estimate Full Plots
# bat fatalities/turbine/year	12.67 (9.55, 18.22)	9.91 (5.73, 20.09)	19.01 (12.25, 35.28)
# bat fatalities/MW/year	6.33 (4.77, 9.11)	4.95 (2.87, 10.05)	9.50 (6.13, 17.64)

Table 6.5-1b. Adjusted bat fatality estimates using the Shoenfeld, Huso, and Empirical Pi estimators for the Grand Meadow Wind Farms for studies conducted from July 12 – October 31, 2013. For more details concerning correction factors and confidence intervals, refer to Appendices D, E, and F.

	Shoenfeld Estimator		Huso Estimator	Empirical Pi Estimator
	Adjusted Fatality Estimate Full Plots	Adjusted Fatality Estimate Road and Pad Plots*	Adjusted Fatality Estimate Full Plots	Adjusted Fatality Estimate Full Plots
# bat fatalities/turbine/year	4.66 (2.73, 8.03)	21.48 (10.37, 47.22)	5.84 (2.98, 12.25)	5.52 (2.86, 10.03)
# bat fatalities/MW/year	3.11 (1.82, 5.36)	14.32 (6.91, 31.48)	3.89 (1.99, 8.17)	3.68 (1.91, 6.69)

* - Adjusted fatality estimate is for the fall period only (August 16 – October 31)

Table 6.5-1c. Adjusted bat fatality estimates using the Shoenfeld, Huso, and Empirical Pi estimators for the Oak Glen Wind Farm for studies conducted from July 15 – October 31, 2013. For more details concerning correction factors and confidence intervals, refer to Appendices D, E, and F.

	Shoenfeld Estimator	Huso	Empirical Pi Estimator
	Adjusted Fatality Estimate Full Plots	Adjusted Fatality Estimate Full Plots	Adjusted Fatality Estimate Full Plots
# bat fatalities/turbine/year	5.56 (3.59, 9.61)	7.71 (3.46, 19.61)	5.66 (3.47, 9.18)
# bat fatalities/MW/year	3.09 (1.99, 5.34)	4.28 (1.92, 10.90)	3.15 (1.93, 5.10)

6.5.2 Birds

Overall, bird fatality estimates were all less than one bird fatality per MW for the study period for Big Blue, Grand Meadow, or Oak Glen (Tables 6.5-2a – 6.5-2c). Fatality estimates for small birds ranged from 0.53 bird fatalities per MW per study period at Grand Meadow to 0.33 bird fatalities per MW per study period at Big Blue, with respect to Shoenfeld estimates (Tables 6.5-2a – 6.5-2c). No large birds were found at Grand Meadow or Oak Glen, therefore the estimated fatality rate is zero. Using Shoenfeld estimates, the large bird estimated fatality rate at Big Blue is 0.07 (CI: 0-0.21; Table 6.5-2a).

Table 6.5-2a. Adjusted bird fatality estimates for 120-m x 120-m plots using the Shoenfeld, Huso, and Empirical Pi estimators for the Big Blue Wind Farm for studies conducted from July 9 – October 31, 2013. For more details concerning correction factors and confidence intervals, refer to Appendix D.

	Shoenfeld Adjusted Fatality Estimate	Huso Adjusted Fatality Estimate	Empirical Pi Adjusted Fatality Estimate
# small bird fatalities/MW/study period	0.33 (0.09, 0.81)	0.65 (0.17, 2.18)	0.41 (0.11, 1.09)
# large bird fatalities/MW/study period	0.07 (0, 0.21)	0.09 (0, 0.27)	0.08 (0, 0.23)
# all bird fatalities/MW/study period	0.40 (0.12, 0.90)	0.74 (0.18, 2.25)	0.49 (0.14, 1.23)

Table 6.5-2b. Adjusted bird fatality estimates for 120-m x 120-m plots using the Shoenfeld, Huso, and Empirical Pi estimators for the Grand Meadow Wind Farm for studies conducted from July 12 – October 31, 2013. For more details concerning correction factors and confidence intervals, refer to Appendix E.

	Shoenfeld Adjusted Fatality Estimate	Huso Adjusted Fatality Estimate	Empirical Pi Adjusted Fatality Estimate
# small bird fatalities/MW/study period	0.53 (0.16, 1.25)	0.72 (0.14, 2.54)	0.80 (0.21, 2.19)
# large bird fatalities/MW/study period	0	0	0
# all bird fatalities/MW/study period	0.53 (0.16, 1.25)	0.72 (0.14, 2.54)	0.80 (0.21, 2.19)

Table 6.5-2c. Adjusted bird fatality estimates for 120-m x 120-m plots using the Shoenfeld, Huso, and Empirical Pi estimators for the Oak Glen Wind Farm for studies conducted from July 15 – October 31, 2013. For more details concerning correction factors and confidence intervals, refer to Appendix F.

	Shoenfeld Adjusted Fatality Estimate	Huso Adjusted Fatality Estimate	Empirical Pi Adjusted Fatality Estimate
# small bird fatalities/MW/study period	0.51 (0.22, 1.01)	0.72 (0.24, 1.80)	0.51 (0.21, 0.96)
# large bird fatalities/MW/study period	0	0	0
# all bird fatalities/MW/study period	0.51 (0.22, 1.01)	0.72 (0.24, 1.80)	0.51 (0.21, 0.96)

6.6 Weather and Fatality Correlation Analysis

The top multivariate models for Big Blue, Grand Meadow, and Oak Glen are included in Tables 4.4-3a – 4.4-3c. Out of a possible 32 models for Big Blue, eight models had the best fit (Table 4.4-3a). Similarly out of a possible 40 models for Grand Meadow and a possible 30 models for Oak Glen, a total of five models had the best fit for Grand Meadow and six for Oak Glen (Tables 4.4-3b and 4.4-3c). The top model for Big Blue included average nightly standard deviation of wind speed variable and took the following form:

$$\log(\text{probability of } \geq 1 \text{ fatalitiy}) = -0.33 - 1.67*(\text{Standard Deviation of Wind Speed});$$

Grand Meadow included the average nightly temperature and average rotor speed variables and is:

$$\log(\text{probability of } \geq 1 \text{ fatalitiy}) = -04.24 - 0.22*(\text{Average Rotor Speed}) - 3.66*(\text{Standard Deviation of Wind Speed}) + 0.14*(\text{Average Temperature});$$

Oak Glen included average nightly standard deviation of wind speed variable, the average nightly temperature, the average rotor speed, and the average pressure variables and is as follows:

$$\log(\text{probability of } \geq 1 \text{ fatalitiy}) = -2.13 + 0.27*(\text{Average Rotor Speed}) - 0.02*(\text{Average Rotor Speed})^2 + 0.11*(\text{Average Temperature}).$$

The top model for Big Blue included the average nightly standard deviation of wind speed variable. As the variability in wind speeds increased, the probability of one or more bat fatalities decreased (Figure 6.6-1).

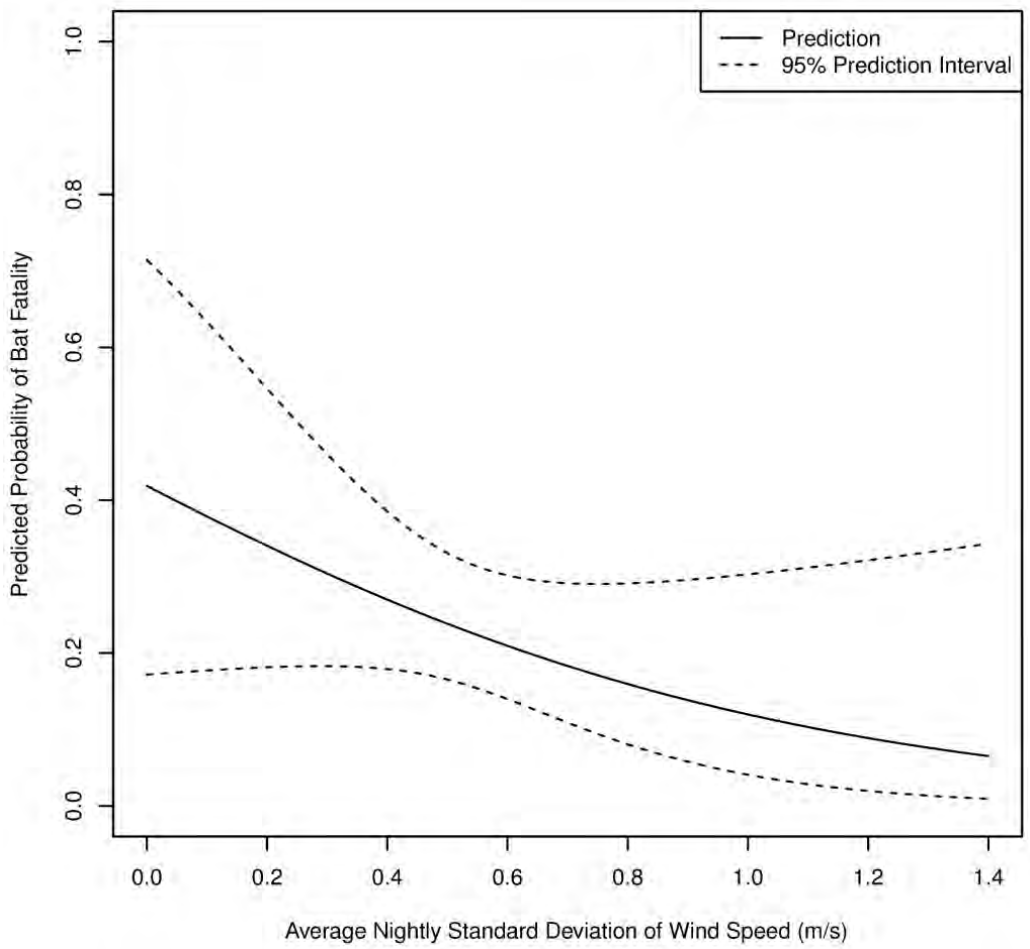


Figure 6.6-1. The predicted probability of finding one or more fresh bat fatalities relative to average nightly wind speeds at the Big Blue Wind Farm from July 9 to October 31, 2013.

The positive coefficients for the average temperature variable in top models at Big Blue suggest that as the average nightly temperature increases, the probability of a bat fatality increases (Table 4.4-2a).

Similarly, at Grand Meadow, the model suggests that as the average nightly temperature increases, the probability of one or more bat fatalities increases (Figure 6.6-2).

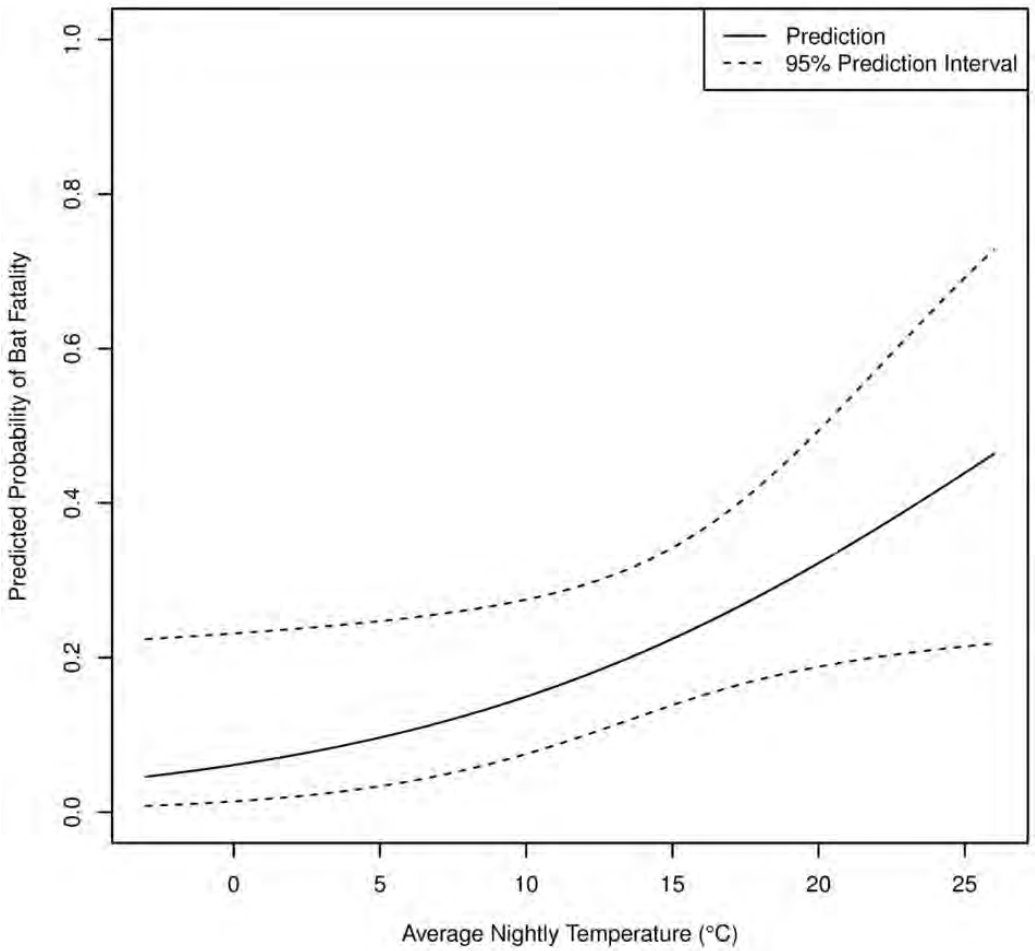


Figure 6.6-2. The predicted probability of finding one or more fresh bat fatalities relative to average nightly temperatures with an average nightly rotor speed of 13.12 m/sec at the Grand Meadow Wind Farm from July 12 to October 31, 2013.

A quadratic term for average nightly rotor and wind speed were included in the top models as well. The quadratic term suggests that as speeds increase from zero the probability of at least one bat fatality increases but once the maximum probability of at least one bat fatality is reached and the speeds continue to increase a decrease in the probability of at least one bat fatality is observed (Figure 6.6-3). Average nightly wind speed and average nightly rotor speed were highly correlated (r = 0.93) and the variables were not considered in the same model (Table 4.4-3b).

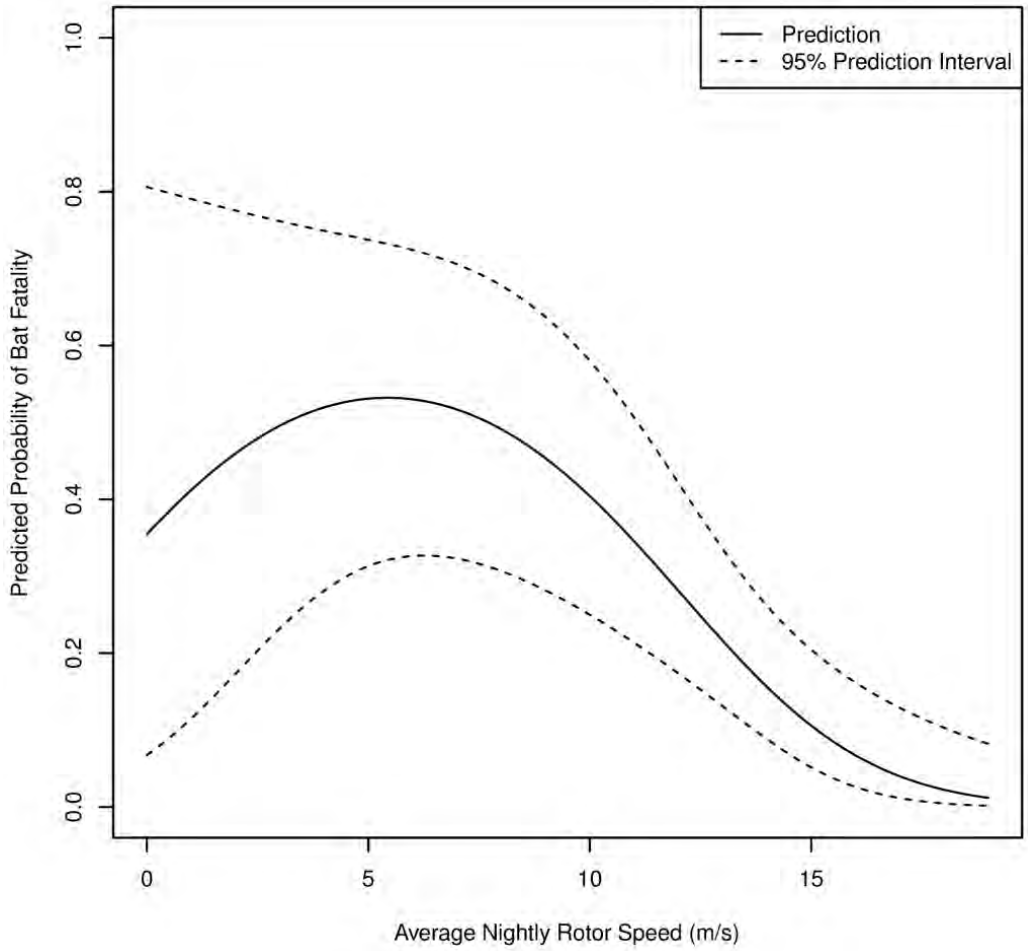


Figure 6.6-3. The predicted probability of finding one or more fresh bat fatalities relative to average nightly rotor speed with an average nightly temperature of 14.0°C at the Grand Meadow Wind Farm from July 12 to October 31, 2013.

Average nightly pressure had a positive coefficient, (Table 4.4-2b) which indicates that the predicted probability of at least one bat fatality increases as average nightly barometric pressure increases. In top models at Grand Meadows a negative coefficient is observed for the precipitation indicator suggesting that when precipitation is present the probability of at least one bat fatality is less than the probability of at least one bat fatality when no precipitation is present (Table 4.4-2b).

One of the top models for Oak Glen included the average nightly standard deviation of wind speed variable. As the variability in wind speeds increased, the model suggests that the probability of one or more bat fatalities decreased (Figure 6.6-4).

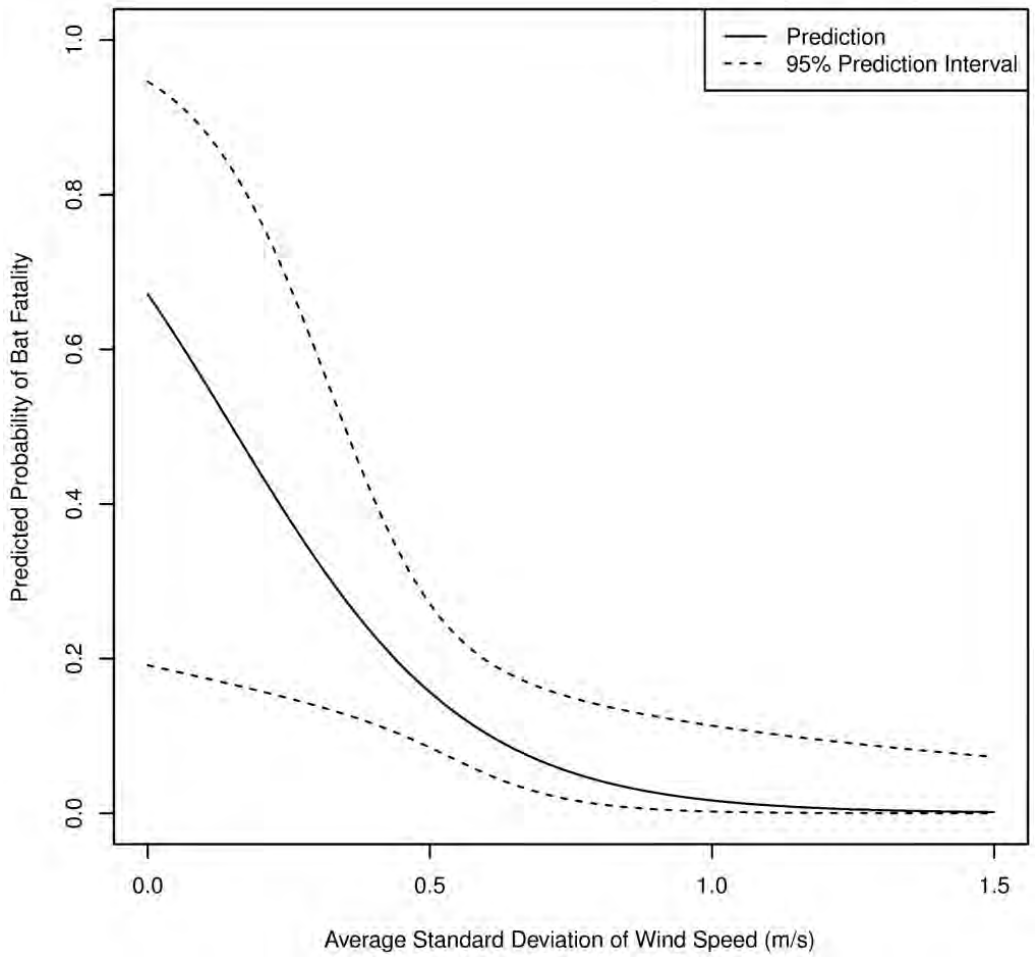


Figure 6.6.4. The predicted probability of finding one or more fresh bat fatalities relative to average nightly standard deviation of wind speed at the Oak Glen Wind Farm from July 15 to October 31, 2013. (Average nightly pressure of 97.17 millibars; average nightly temperature of 14.7°C, and average rotor speed of 10.27 m/sec)

All other variables, excluding average pressure, in the final model for Oak Glen had positive coefficients (i.e., a direct relationship), suggesting that as they increased, the estimated likelihood of a bat fatality increased (Figures 6.6-5, 6.6-6). To clarify, as the average nightly temperature increased, the estimated probability of observing at least one bat fatality increased (Figure 6.6-5) and as the average nightly rotor speed increased, the predicted probability of one or more bat fatalities increased (Figure 6.6-6). The opposite was true for pressure; as the average pressure increased, the predicted probability of at least one bat fatality decreased (Figure 6.6-7).

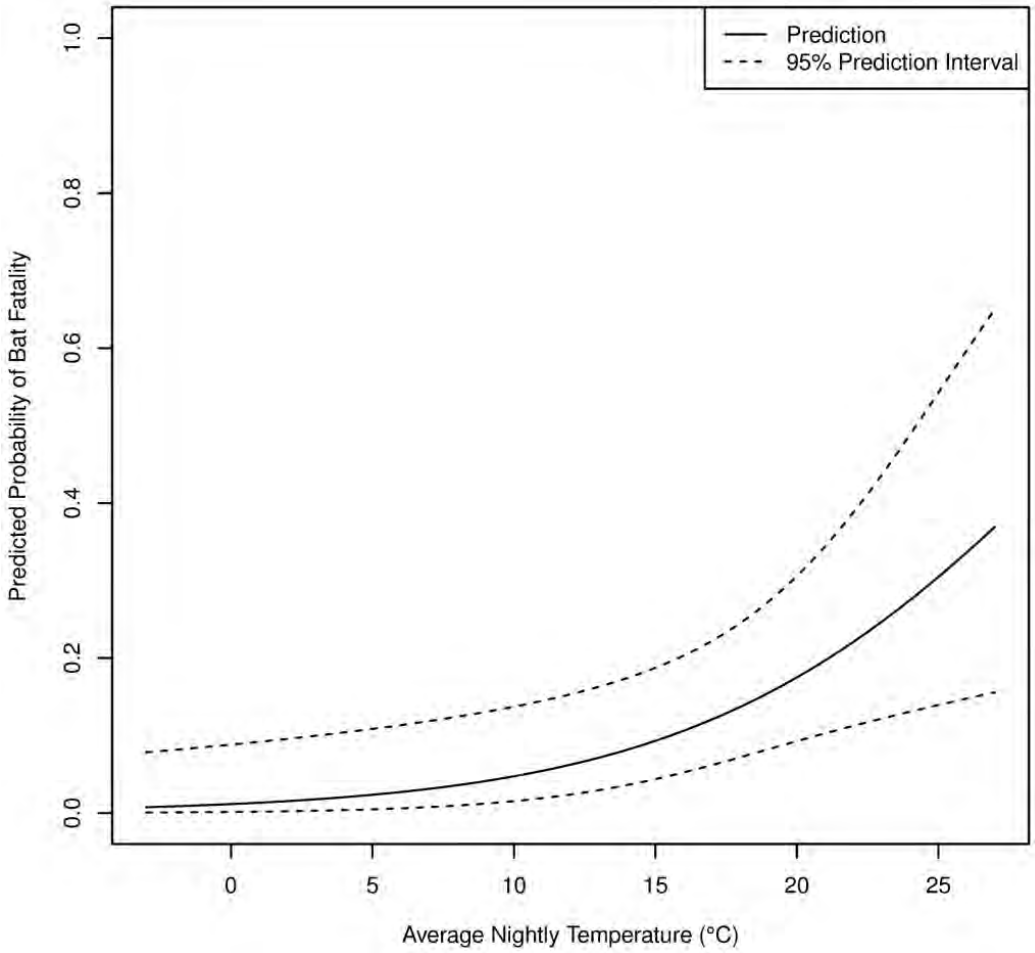


Figure 6.6-5. The predicted probability of finding one or more fresh bat fatalities relative to average nightly temperatures at the Oak Glen Wind Farm from July 15 to October 31, 2013. (Average nightly pressure of 97.17 millibars; average standard deviation of wind speed of 0.6317, and average rotor speed of 10.27 m/sec)

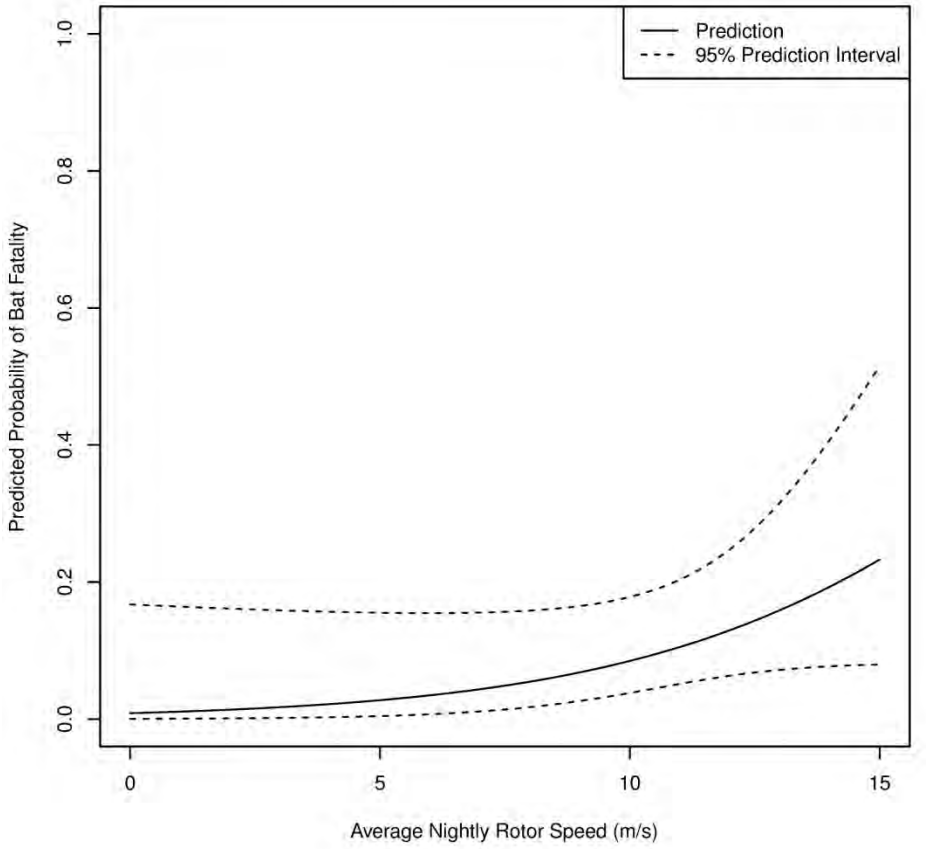


Figure 6.6-6. The predicted probability of finding one or more fresh bat fatalities relative to average nightly rotor speed at the Oak Glen Wind Farm from July 15 to October 31, 2013. (Average nightly pressure of 97.17 millibars; average nightly temperature of 14.7°C, and average standard deviation of wind speed of 0.6317)

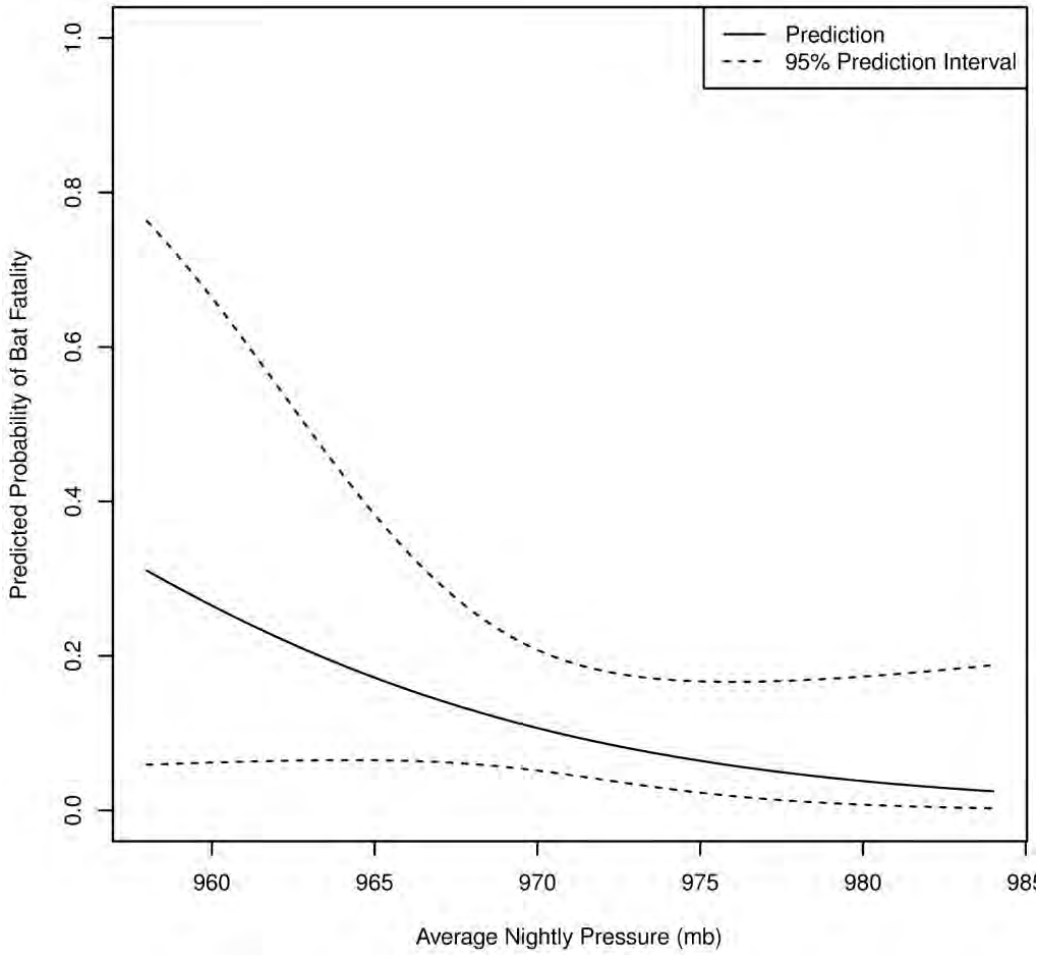


Figure 6.6-7. The predicted probability of finding one or more fresh bat fatalities relative to average nightly pressure at the Oak Glen Wind Farm from July 15 to October 31, 2013. (Average nightly temperature of 14.7°C, average rotor speed of 10.27 m/sec, and average standard deviation of wind speed of 0.6317)

6.7 Listed Species

No state or federally endangered or threatened bat or avian species were identified during fatality monitoring. However, the range of the northern long-eared bat (*Myotis septentrionalis*), a federal-proposed endangered species (USFWS 2013), encompasses Big Blue, Grand Meadow, and Oak Glen.

7.0 DISCUSSION

Concern has been raised regarding biases associated with fatality monitoring at wind facilities and the following paragraphs briefly identify these biases and how they were addressed. The approach used for calculating adjusted fatality estimates was consistent with the approach outlined by Shoenfeld (2004), Huso (2011), and Empirical Pi, and accounted for search interval, total area searched, proportion of area searched at specific distances from the turbine, searcher efficiency rates, and carcass removal rates. It is hypothesized that scavenging could change

through time at a given location and must be accounted for when attempting to estimate fatality rates. This was accounted for by conducting scavenging trials for bats, and small and large birds throughout each search period. Searcher efficiency trials were also conducted throughout each search period within different plot conditions to account for any biases. As vegetation density or height increased, the level of difficulty in detection rates also increased. Separate fatality rate estimates were calculated for bats, small birds, and large birds based on search interval and season.

There are numerous factors that could contribute to both positive and negative biases in estimating fatality rates (Erickson 2006). The overall design of this study incorporates several assumptions or factors that affect the results of the fatality estimates. First, all bat and bird casualties found within the standardized search plots during the study were included in the analysis. Second, it was assumed that all bat and bird carcasses found during the study were due to collision with wind turbines. True cause of death was unknown for most of the fatalities. It is possible that some of the bird or bat fatalities were caused by predators, and some of the casualties included in the data pool were potentially due to natural causes (background mortality).

Another possible bias is that no adjustments were made for fatalities possibly occurring outside of the search boundaries. Search boundaries were established a minimum distance of 60 m (198 ft) from the turbines to focus on bats. However, given the small percentages of bat fatalities found at these further distances, it is unlikely that many fatalities would have been outside the plots. This factor may lead to a slight underestimate of fatality rates (Tables 6.2-1a – 6.2-1f and Tables 6.2-3a – 6.2-3d).

Concern has also been raised regarding how the number of carcasses placed in the field for carcass removal trials on a given day could lead to biased estimates of scavenging rates. Hypothetically, this would lead to underestimating true scavenging rates if the scavenger densities are low enough such that scavenging rates for these placed carcasses are lower than for actual fatalities. The logic is that if the trials are based on too many carcasses on a given day, scavengers are unable to access all trial carcasses, whereas they could potentially access and remove all wind turbine collision fatalities (Smallwood et al. 2010). If this is the case, and the trial carcass density was much greater than actual turbine fatality density, the trials would underestimate scavenging rates compared to rates on actual fatalities. Conversely, placing carcasses in an area could bring in additional scavengers, therefore artificially overestimating scavenging rates compared to actual fatalities with ongoing trials.

7.1 Bat Fatalities

During this study, a combined total of 199 bat fatalities were found from July 9 to October 31, 2013, at Big Blue, Grand Meadow, and Oak Glen. This timing is consistent with results from other fatality studies in the US which have shown a peak in mortality in August and September and generally lower mortality earlier in the summer (Johnson 2005, Arnett et al. 2008).

The majority of bat fatalities identified at Big Blue, Grand Meadow, and Oak Glen were primarily composed of two migratory tree-roosting bats (eastern red bat and hoary bat), which is similar to the species composition of fatalities at most other wind energy facilities in the Midwest (Jain 2005; Gruver et al. 2009, 2011). Based on the timing, the majority of bat fatalities were likely fall migrants through the site, as is the case at virtually all other wind energy facilities in North America (Johnson 2005, Arnett et al. 2008).

Bat fatality estimates from other wind energy facilities across North America ranged from 0.10 bat fatalities/megawatt/year at the Buffalo Gap I facility in Texas (Tierney 2007) to 39.70 at the Buffalo Mountain facility in Tennessee (Fiedler et al. 2007; Appendix G). Within in the Midwest, bat fatality estimates ranged from 0.16 to 30.61 bat fatalities/MW/year (Table 7.1-1).

For comparison purposes, the Shoenfeld estimates are referred to since several of the comparison studies used this estimator, and due to the discrepancies with Empirical Pi and Huso. With Empirical Pi, the bias correction factor depends on a balanced distribution of trial carcasses placed throughout the search interval. To appropriately estimate the bias correction factor, carcasses should be placed the same day as scheduled carcass searches, as well as one day prior to carcass searches, to account for removal time. At Big Blue, Grand Meadow, and Oak Glen, carcasses were only placed the same day as carcass searches, and as such, the Empirical Pi estimates do not account for carcasses removed after one day. Therefore, the Empirical Pi estimates for Big Blue, Grand Meadow, and Oak Glen are biased high, resulting in an underestimate of the overall adjusted fatality estimate. Similarly the fatality rates calculated with the Huso estimator are biased low. At Big Blue, Grand Meadow, and Oak Glen, carcasses for bias trials were placed on search plots and were monitored for 30 days. A majority of the bat carcasses did not remain in the field for the entirety of the trial. The average carcass removal time for bats at Big Blue, Grand Meadows, and Oak Glen was 6.7, 5.8, and 8.5 days, respectively. Any carcass that was not found or did not remain in the trial until the end of the 30-day period was not included in the multiple-search searcher efficiency estimate. Therefore, the limited number of carcasses available to be found by searches caused the multiple-search searcher efficiency rate to be biased high resulting in an underestimate of the overall adjusted fatality estimate.

The Shoenfeld estimated bat fatality rate of 6.33 bat fatalities/MW/year for Big Blue is within the upper range of other facilities in the Midwest, ranking 14th overall (Figure 7.1-1). Fatality estimates using the Shoenfeld estimator for Grand Meadow (3.11 bat fatalities/MW/year) and Oak Glen (3.09 bat fatalities/MW/year) are within the range of other facilities in Midwest, ranking 21st and 20th, respectively (Figure 7.1-1). The fatality estimates at Big Blue are similar to the nearby Winnebago, IA facility and are less than the estimated range for the nearby Lakefield facility (Table 7.1-1).

Based on one year of fatality monitoring results for Big Blue, Grand Meadow, and Oak Glen, it is difficult to determine if there will be population impacts to migratory tree-roosting bat species, including, but not limited to, hoary bats and eastern red bats. Clear direction on this is not possible given the lack of overall population estimates.

Table 7.1-1. Wind energy facilities in the Midwest with comparable and publicly-available activity and fatality data for bat species.

Wind Energy Facility	Bat Activity Estimate[A]	Fatality Estimate[B]	No. of Turbines	Total MW
Cedar Ridge, WI (2009)	9.97[C,D,E,F]	30.61	41	67.6
Blue Sky Green Field, WI	7.7[F,]	24.57	88	145
Cedar Ridge, WI (2010)	9.97[C,D,E,F]	24.12	41	68
Fowler I, II, III, IN (2011)		20.19	355	600
Fowler I, II, III, IN (2010)		18.96	355	600
Forward Energy Center, WI	6.97	18.17	86	129
Lakefield, MN (2012)		15.85 – 22.65	137	205.5
Big Blue, MN (This study)		**11.15**	**18**	**36**
Harrow, Ont (2010)		11.13	24	39.6
Top of Iowa, IA (2004)	35.7	10.27	89	80
Pioneer Prairie I, IA (Phase II)		10.06	62	102.3
Fowler I, IN (2009)		8.09	162	301
Crystal Lake II, IA		7.42	80	200
Top of Iowa, IA (2003)		7.16	89	80
Kewaunee County, WI		6.45	31	20.46
Grand Meadow, MN (This study)		**5.84**	**67**	**100.5**
Oak Glen, MN (This study)		**4.71**	**24**	**36**
Ripley, Ont. (2008)		4.67	38	76
Winnebago, IA		4.54	10	20
Buffalo Ridge, MN (Phase II; 2001/Lake Benton I)	2.2[D]	4.35	143	107.25
Buffalo Ridge, MN (Phase III; 2001/Lake Benton II)	2.2[D]	3.71	138	103.5
Crescent Ridge, IL		3.27	33	54.45
Fowler I, II, III, IN (2012)		2.96	355	600
Elm Creek II, MN		2.81	62	148.8
Buffalo Ridge II, SD (2011)		2.81	105	210
Buffalo Ridge, MN (Phase III; 1999)		2.72	138	103.5
Buffalo Ridge, MN (Phase II; 1999)		2.59	143	107.25
Moraine II, MN		2.42	33	49.5
Buffalo Ridge, MN (Phase II; 1998)		2.16	143	107.25
Prairie Winds (Minot), ND		2.13	80	115.5
Grand Ridge, IL		2.1	66	99
Barton I & II, IA		1.85	80	160
Fowler III, IN (2009)		1.84	60	99
Buffalo Ridge, MN (Phase III; 2002/Lake Benton II)	1.9[D]	1.81	138	103.5
Buffalo Ridge, MN (Phase II; 2002/Lake Benton I)	1.9[D]	1.64	143	107.25
Rugby, ND		1.6	71	149
Elm Creek, MN		1.49	67	100
Wessington Springs, SD		1.48	34	51
Prairie Winds ND1 (Minot), ND 2011		1.39	80	115.5
Prairie Winds SD1 (Crow Lake), SD		1.23	108	162
NPPD Ainsworth, NE		1.16	36	20.5
Buffalo Ridge, MN (Phase I; 1999)		0.74	73	25
Wessington Springs, SD (2010)		0.41	34	51
Buffalo Ridge I, SD (2010)		0.16	24	50.4

A=bat passes per detector-night; B=number of bats fatalities/MW/year; C=Activity rate based on data collected at various heights; all other activity rates are from ground-based units only; D=Activity rate was averaged across phases and/or study years; E=Activity rate calculated by WEST from data presented in referenced report; F=Activity rate based on pre-construction monitoring; other data were collected concurrently

Table 7.1-1 (*continued*). Wind energy facilities in the Midwest with comparable and publicly-available activity and fatality data for bat species.

Data from the following sources:

Facility	Activity Estimate	Fatality Estimate	Facility	Activity Estimate	Fatality Estimate
Big Blue, MN		This study			
Grand Meadow, MN		This study			
Oak Glen, MN		This study			
Barton I&II, IA		Derby et al. 2011a	Fowler III, IN (09)		Good et al. 2011
Blue Sky Green Field, WI	Gruver 2008	Gruver et al. 2009	Fowler I, II, III, IN (10)		Good et al. 2011
Buffalo Ridge, MN (Ph. I; 99)		Johnson et al. 2000	Fowler I, II, III, IN (11)		Good et al. 2012
Buffalo Ridge, MN (Ph. II; 98)		Johnson et al. 2000	Fowler I, II, III, IN (12)		Good et al. 2013
Buffalo Ridge, MN (Ph. II; 99)		Johnson et al. 2000	Grand Ridge, IL		Derby et al. 2010g
Buffalo Ridge, MN (Ph. II; 01/Lake Benton I)	Johnson et al. 2004	Johnson et al. 2004	Harrow, Ont. (10)		NRSI 2011
Buffalo Ridge, MN (Ph. II; 02/Lake Benton I)	Johnson et al. 2004	Johnson et al. 2004	Kewaunee County, WI		Howe et al. 2002
Buffalo Ridge, MN (Ph. III; 99)		Johnson et al. 2000	Moraine II, MN		Derby et al. 2010d
Buffalo Ridge, MN (Ph. III; 01/Lake Benton II)	Johnson et al. 2004	Johnson et al. 2004	NPPD Ainsworth, NE		Derby et al. 2007
Buffalo Ridge, MN (Ph. III; 02/Lake Benton II)	Johnson et al. 2004	Johnson et al. 2004	Pioneer Prairie, IA (Ph. II)		Chodachek et al. 2012
Buffalo Ridge I, SD (10)		Derby et al. 2010b	PrairieWinds ND1 (Minot), ND		Derby et al. 2011c
Buffalo Ridge II, SD (11)		Derby et al. 2012a	PrairieWinds ND1 (Minot), ND (11)		Derby et al. 2012c
Cedar Ridge, WI (09)	BHE Environmental 2008	BHE Environmental 2010	PrairieWinds SD1, SD		Derby et al. 2012d
Cedar Ridge, WI (10)	BHE Environmental 2008	BHE Environmental 2011	Ripley, Ont (08)		Jacques Whitford 2009
Crescent Ridge, IL		Kerlinger et al. 2007	Rugby, ND		Derby et al. 2011b
Crystal Lake II, IA		Derby et al. 2010a	Top of Iowa, IA (03)		Jain 2005
Elm Creek, MN		Derby et al. 2010c	Top of Iowa, IA (04)	Jain 2005	Jain 2005
Elm Creek II, MN		Derby et al. 2012b	Wessington Springs, SD (09)		Derby et al. 2010f
Forward Energy Center, WI	Watt and Drake 2011	Grodsky and Drake 2011	Wessington Springs, SD (10)		Derby et al. 2011d
Fowler I, IN (09)		Good et al. 2011	Winnebago, IA		Derby et al. 2010e

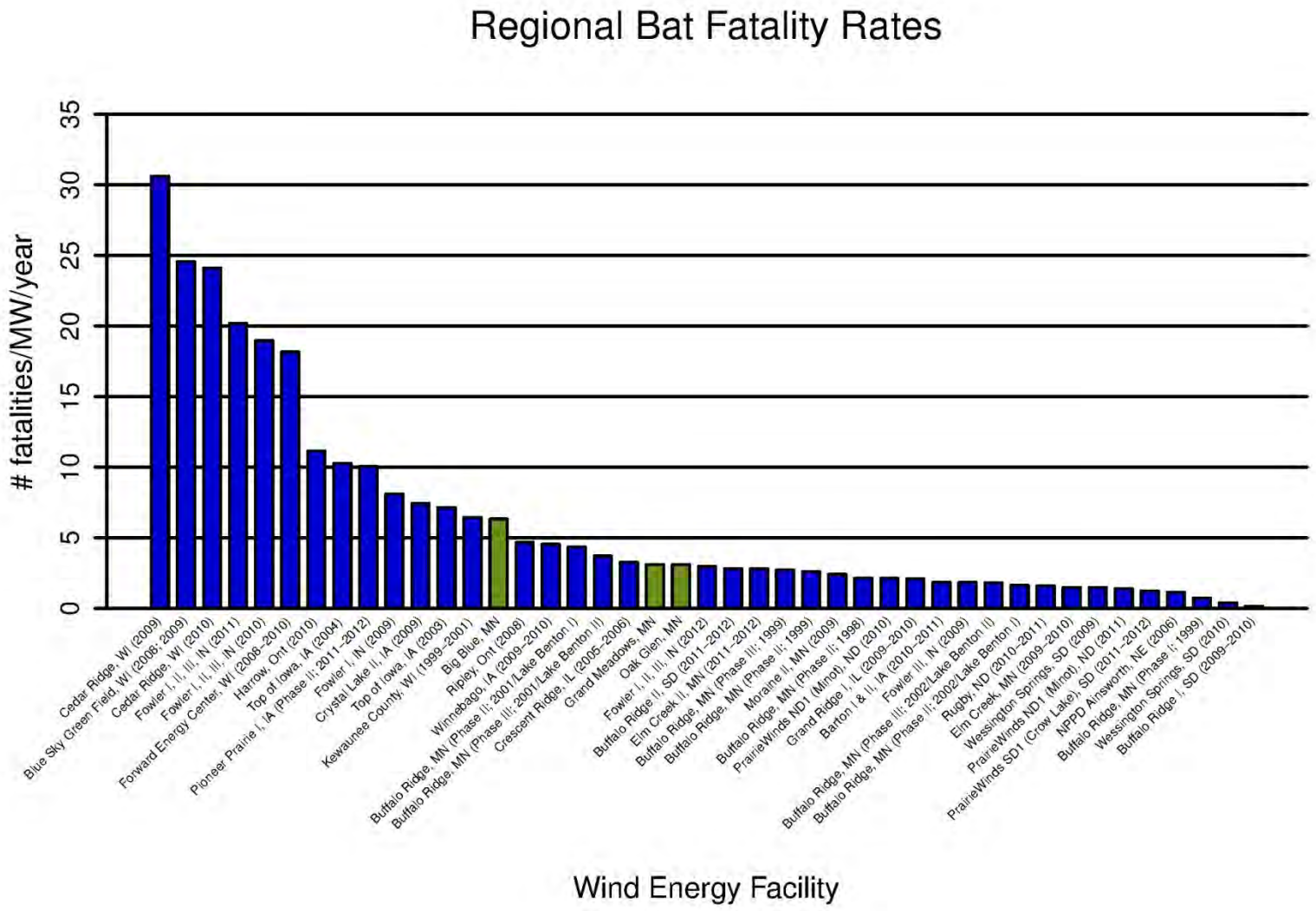


Figure 7.1-1. All bat fatality rates from comparable and publicly-available studies at Midwest wind energy facilities, with Big Blue, Grand Meadow, and Oak Glen highlighted in green.

Figure 7.1-1 (*continued*). All bat fatality rates from comparable and publicly-available studies at Midwest wind energy facilities.
Data from the following sources:

Facility, Location	Fatality Reference	Facility, Location	Fatality Reference	Facility, Location	Fatality Reference
Big Blue, MN	This study				
Grand Meadow, MN	This study				
Oak Glen, MN	This study				
Cedar Ridge, WI (09)	BHE Environmental 2010	Winnebago, IA (09-10)	Derby et al. 2010e	Fowler III, IN (09)	Good et al. 2011
Blue Sky Green Field, WI (08; 09)	Gruver et al. 2009	Buffalo Ridge, MN (Ph. II; 01; 02/Lake Benton I)	Johnson et al. 2004	Buffalo Ridge, MN (Ph. III; 01;02/Lake Benton II)	Johnson et al. 2004
Cedar Ridge, WI (10)	BHE Environmental 2011	Buffalo Ridge, MN (Ph. III; 01;02/Lake Benton II)	Johnson et al. 2004	Buffalo Ridge, MN (Ph. II; 01; 02/Lake Benton I)	Johnson et al. 2004
Fowler I, II, III, IN (11)	Good et al. 2012	Crescent Ridge, IL (05-06)	Kerlinger et al. 2007	Rugby, ND (09-10)	Derby et al. 2011b
Fowler I, II, III, IN (10)	Good et al. 2011	Fowler I, II, III, IN (12)	Good et al. 2013	Elm Creek, MN	Derby et al. 2010c
Forward Energy Center, WI (08-10)	Grodsky and Drake 2011	Buffalo Ridge II, SD (11-12)	Derby et al. 2012a	Wessington Springs, SD (09)	Derby et al. 2010f
Harrow, Ont. (10)	NRSI 2011	Elm Creek II, MN (11-12)	Derby et al. 2012b	PrairieWinds ND1 (Minot), ND (11)	Derby et al. 2012c
Top of Iowa, IA (04)	Jain 2005	Buffalo Ridge, MN (Ph. III; 99)	Johnson et al. 2000	PrairieWinds SD1 (Crow Lake), SD (11-12)	Derby et al. 2012d
Pioneer Prairie, IA (Ph. II; 11-12)	Chodachek et al. 2012	Buffalo Ridge, MN (Ph. II; 99)	Johnson et al. 2000	NPPD Ainsworth, NE (06)	Derby et al. 2007
Fowler I, IN (09)	Good et al. 2011	Moraine II, MN (09)	Derby et al. 2010d	Buffalo Ridge, MN (Ph. I; 99)	Johnson et al. 2000
Crystal Lake II, IA (09)	Derby et al. 2010a	Buffalo Ridge, MN (Ph. II; 98)	Johnson et al. 2000	Wessington Springs, SD (10)	Derby et al. 2011d
Top of Iowa, IA (03)	Jain 2005	PrairieWinds ND1 (Minot), ND (10)	Derby et al. 2011c	Buffalo Ridge I, SD (10)	Derby et al. 2010b
Kewaunee County, WI (99-01)	Howe et al. 2002	Grand Ridge, IL (09-10)	Derby et al. 2010g		
Ripley, Ont (08)	Jacques Whitford 2009	Barton I& II, IA (10-11)	Derby et al. 2011a		

7.2 Bird Fatalities

During the study period, a combined total of 16 bird fatalities were found during scheduled carcass searches at Big Blue, Grand Meadow, and Oak Glen. No bird fatalities were federally listed (e.g., Endangered Species Act [ESA 1973]) or State listed and none were raptor species.

Due to the limited survey period and the emphasis of the study on bat fatalities, the estimated bird fatality rates for Big Blue, Grand Meadow, and Oak Glen are not comparable to other sites within the region. However bird fatalities as measured during this short monitoring period do not appear to constitute a major concern by the number or species.

7.3 Correlation Analysis

In general at Big Blue, Grand Meadow, and Oak Glen, the probability for one or more bat fatalities had the highest linear correlation with rotor speed and variability in wind speed (i.e. standard deviation of wind speed). This analysis was limited due to the small sample size of fresh bat fatalities found during Year 1. As monitoring continues, these models can be updated to include the additional fresh fatalities found during scheduled carcass searches. As more data are available, a negative binomial or zero-inflated negative binomial model can be considered to estimate the number of bat fatalities per night and determine if any correlations exist.

7.4 Protocol Recommendations

Based on results from 2013 surveys, searcher efficiency and carcass removal trials for bats should be limited to a 7- or 14-day period to reflect removal rates.

For surveys occurring within full plots, it is recommended that removal of crops occur during the growing season. During 2013, several issues arose as a result of searching fully vegetated plots. Issues included health and safety concerns with crop spraying and reduced visibility, increased survey time for plots, and reduced survey areas due to inability to survey in heavily vegetated fields. If crop removal is not financially feasible, it is suggested that plot searches become road and pad searches once the vegetation becomes too dense and tall to survey and plot searches will not resume until agricultural fields are harvested.

8.0 SUMMARY

The bat fatality rate at Big Blue, Grand Meadow, and Oak Glen are within the overall range for other Midwestern projects, and lower than many facilities in the east (Appendix G). Migratory bats, including but not limited to eastern red bats and hoary bats, made up the majority of all bat fatalities. No state or federally endangered or threatened bat species were located as a fatality.

9.0 REFERENCES

Arnett, E. B., K. Brown, W. P. Erickson, J. Fiedler, B. L. Hamilton, T. H. Henry, A. Jain, G. D. Johnson, J. Kerns, R. R. Kolford, C. P. Nicholson, T. O'Connell, M. Piorkowski, and R. Tankersley, Jr. 2008. Patterns of Bat Fatalities at Wind Energy Facilities in North America. Journal of Wildlife Management 72(1): 61-78.

Arnett, E. B., W. P. Erickson, J. Kerns, and J. Horn. 2005. Relationships between Bats and Wind Turbines in Pennsylvania and West Virginia: An Assessment of Fatality Search Protocols, Patterns of Fatality, and Behavioral Interactions with Wind Turbines. Prepared for the Bats and Wind Energy Cooperative. March 2005.

Arnett, E. B., M. R. Schirmacher, C. D. Hein, and M. M. P. Huso. 2011. Patterns of Bird and Bat Fatality at the Locust Ridge II Wind Project, Pennsylvania. 2009-2010 Final Report. Prepared for the Bats and Wind Energy Cooperative (BWEC) and the Pennsylvania Game Commission (PGC). Prepared by Bat Conservation International (BCI), Austin, Texas. January 2011.

Arnett, E. B., M. R. Schirmacher, M. M. P. Huso, and J. P. Hayes. 2009a. Effectiveness of Changing Wind Turbine Cut-in Speed to Reduce Bat Fatalities at Wind Facilities: 2008 Annual Report. Prepared for the Bats and Wind Energy Cooperative (BWEC) and the Pennsylvania Game Commission. Bat Conservation International (BCI), Austin, Texas. April 2009. http://www.batsandwind.org/pdf/Curtailment_2008_Final_Report.pdf

Arnett, E. B., M. R. Schirmacher, M. M. P. Huso, and J. P. Hayes. 2009b. Patterns of Bat Fatality at the Casselman Wind Project in South-Central Pennsylvania. 2008 Annual Report. Annual report prepared for the Bats and Wind Energy Cooperative (BWEC) and the Pennsylvania Game Commission. Bat Conservation International (BCI), Austin, Texas. June 2009. Available online at: http://www.batsandwind.org/pdf/2008%20Casselman%20Fatality%20Report.pdf

Arnett, E. B., M. R. Schirmacher, M. M. P. Huso, and J. P. Hayes. 2010. Patterns of Bat Fatality at the Casselman Wind Project in South-Central Pennsylvania. 2009 Annual Report. Annual report prepared for the Bats and Wind Energy Cooperative (BWEC) and the Pennsylvania Game Commission. Bat Conservation International (BCI), Austin, Texas. January 2010.

Baerwald, E. F. 2008. Variation in the Activity and Fatality of Migratory Bats at Wind Energy Facilities in Southern Alberta: Causes and Consequences. Thesis. University of Calgary, Calgary, Alberta, Canada.

BHE Environmental, Inc. (BHE). 2008. Investigations of Bat Activity and Bat Species Richness at the Proposed Cedar Ridge Wind Farm in Fond Du Lac County, Wisconsin. Interim Report prepared for Wisconsin Power and Light.

BHE Environmental, Inc. (BHE). 2010. Post-Construction Bird and Bat Mortality Study: Cedar Ridge Wind Farm, Fond Du Lac County, Wisconsin. Interim Report prepared for Wisconsin Power and Light, Madison, Wisconsin. Prepared by BHE Environmental, Inc. Cincinnati, Ohio. February 2010.

BHE Environmental, Inc. (BHE). 2011. Post-Construction Bird and Bat Mortality Study: Cedar Ridge Wind Farm, Fond Du Lac County, Wisconsin. Final Report. Prepared for Wisconsin Power and Light, Madison, Wisconsin. Prepared by BHE Environmental, Inc. Cincinnati, Ohio. February 2011.

Brown, W. K. and B. L. Hamilton. 2006. Monitoring of Bird and Bat Collisions with Wind Turbines at the Summerview Wind Power Project, Alberta: 2005-2006. Prepared for Vision Quest Windelectric, Calgary, Alberta by TAEM Ltd., Calgary, Alberta, and BLH Environmental Services, Pincher Creek, Alberta. September 2006. http://www.batsandwind.org/pdf/Brown2006.pdf

Burnham, K.P. and D.R. Anderson. 2002. Model selection and multimodel inference: a practical information-theoretic approach. Springer, New York.

Cassella, G, and R.L. Berger. 1990. Statistical Inference. Duxbury Press.

Chapman, S. S., J. M. Omernik, J. A. Freeouf, D. G. Huggins, J. R. McCauley, C. C. Freeman, G. Steinauer, R. T. Angelo, and R. L. Schlepp. 2001a. Ecoregions of Iowa and Missouri. (Color poster with map, descriptive text, summary tables, and photographs.) US Geological Survey (USGS) map (map scale 1:1,950,000). USGS, Reston, Virginia. US Environmental Protection Agency (USEPA). http://www.epa.gov/wed/pages/ecoregions/moia_eco.htm

Chapman, S. S., J. M. Omernik, J. A. Freeouf, D. G. Huggins, J. R. McCauley, C. C. Freeman, G. Steinauer, R. T. Angelo, and R. L. Schlepp. 2001b. Ecoregions of Nebraska and Kansas. (Color poster with map, descriptive text, summary tables, and photographs). US Geological Survey (USGS) map (map scale 1:1,950,000). USGS, Reston, Virginia. US Environmental Protection Agency (USEPA). http://www.epa.gov/wed/pages/ecoregions/ksne_eco.htm

Chatfield, A., W. Erickson, and K. Bay. 2009. Avian and Bat Fatality Study, Dillon Wind-Energy Facility, Riverside County, California. Final Report: March 26, 2008 - March 26, 2009. Prepared for Iberdrola Renewables, Portland, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. June 3, 2009.

Chatfield, A., W. P. Erickson, and K. Bay. 2010. Final Report: Avian and Bat Fatality Study at the Alite Wind-Energy Facility, Kern County, California. Final Report: June 15, 2009 – June 15, 2010. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. Prepared for CH2M HILL, Oakland, California.

Chatfield, A., M. Sonnenberg, and K. Bay. 2012. Avian and Bat Mortality Monitoring at the Alta-Oak Creek Mojave Project, Kern County, California. Final Report for the First Year of Operation March 22, 2011 – June 15, 2012. Prepared for Alta Windpower Development, LLC, Mojave, California. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. September 12, 2012.

Chodachek, K., C. Derby, M. Sonnenberg, and T. Thorn. 2012. Post-Construction Fatality Surveys for the Pioneer Prairie Wind Farm I LLC Phase II, Mitchell County, Iowa: April 4, 2011 – March 31, 2012. Prepared for EDP Renewables, North America LLC, Houston, Texas. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota.

Derby, C., K. Chodachek, and K. Bay. 2010a. Post-Construction Bat and Bird Fatality Study Crystal Lake II Wind Energy Center, Hancock and Winnebago Counties, Iowa. Final Report: April 2009-October 2009. Prepared for NextEra Energy Resources, Juno Beach, Florida. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota. June 2, 2010.

Derby, C., K. Chodachek, K. Bay, and A. Merrill. 2010b. Post-Construction Fatality Survey for the Buffalo Ridge I Wind Project. May 2009 - May 2010. Prepared for Iberdrola Renewables, Inc., Portland, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota.

Derby, C., K. Chodachek, K. Bay, and A. Merrill. 2010c. Post-Construction Fatality Surveys for the Elm Creek Wind Project: March 2009- February 2010. Prepared for Iberdrola Renewables, Inc. (IRI), Portland, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota.

Derby, C., K. Chodachek, K. Bay, and A. Merrill. 2010d. Post-Construction Fatality Surveys for the Moraine II Wind Project: March - December 2009. Prepared for Iberdrola Renewables, Inc. (IRI), Portland, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota.

Derby, C., K. Chodachek, K. Bay, and A. Merrill. 2010e. Post-Construction Fatality Surveys for the Winnebago Wind Project: March 2009- February 2010. Prepared for Iberdrola Renewables, Inc. (IRI), Portland, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota.

Derby, C., K. Chodachek, K. Bay, and S. Nomani. 2011a. Post-Construction Fatality Surveys for the Barton I and II Wind Project: IRI. March 2010 - February 2011. Prepared for Iberdrola Renewables, Inc. (IRI), Portland, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota. Version: September 28, 2011.

Derby, C., K. Chodachek, K. Bay, and S. Nomani. 2011b. Post-Construction Fatality Surveys for the Rugby Wind Project: Iberdrola Renewables, Inc. March 2010 - March 2011. Prepared for Iberdrola Renewables, Inc. (IRI), Portland, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota. Version: October 14, 2011.

Derby, C., K. Chodachek, and M. Sonnenberg. 2012a. Post-Construction Casualty Surveys for the Buffalo Ridge II Wind Project. Iberdrola Renewables: March 2011- February 2012. Prepared for Iberdrola Renewables, LLC, Portland, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota. August 31, 2012.

Derby, C., K. Chodachek, and M. Sonnenberg. 2012b. Post-Construction Fatality Surveys for the Elm Creek II Wind Project. Iberdrola Renewables: March 2011-February 2012. Prepared for Iberdrola Renewables, LLC, Portland, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota. October 8, 2012.

Derby, C., K. Chodachek, T. Thorn, K. Bay, and S. Nomani. 2011c. Post-Construction Fatality Surveys for the PrairieWinds ND1 Wind Facility, Basin Electric Power Cooperative, March - November 2010. Prepared for Basin Electric Power Cooperative, Bismarck, North Dakota. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota. August 2, 2011.

Derby, C., K. Chodachek, T. Thorn, and A. Merrill. 2012c. Post-Construction Surveys for the PrairieWinds ND1 (2011) Wind Facility Basin Electric Power Cooperative: March - October 2011. Prepared for Basin Electric Power Cooperative, Bismarck, North Dakota. Prepared by Western Ecosystems Technology, Inc. (WEST), Bismarck, North Dakota. August 31, 2012.

Derby, C., A. Dahl, K. Bay, and L. McManus. 2011d. 2010 Post-Construction Monitoring Results for the Wessington Springs Wind Energy Facility, South Dakota. Final Report: March 9 – November 16, 2010. Prepared for Wessington Wind Energy Center, LLC, Juno Beach, Florida. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota. November 22, 2011.

Derby, C., A. Dahl, W. Erickson, K. Bay, and J. Hoban. 2007. Post-Construction Monitoring Report for Avian and Bat Mortality at the NPPD Ainsworth Wind Farm. Unpublished report prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming, for the Nebraska Public Power District.

Derby, C., A. Dahl, and A. Merrill. 2012d. Post-Construction Monitoring Results for the PrairieWinds SD1 Wind Energy Facility, South Dakota. Final Report: March 2011 - February 2012. Prepared for Basin Electric Power Cooperative, Bismarck, North Dakota. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota. September 27, 2012.

Derby, C., A. Dahl, A. Merrill, and K. Bay. 2010f. 2009 Post-Construction Monitoring Results for the Wessington Springs Wind-Energy Facility, South Dakota. Final Report. Prepared for Wessington Wind Energy Center, LLC, Juno Beach, Florida. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota. August 19, 2010.

Derby, C., G. Iskali, S. Howlin, T. Thorn, T. Lyon, and A. Dahl. 2013a. Post-Construction Monitoring Results for the Big Smile Wind Farm, Roger Mills County, Oklahoma. Final Report: March 2012 to February 2013. Prepared for Acciona Wind Energy, Chicago, Illinois. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota. June 12, 2013.

Derby, C., G. Iskali, M. Kauffman, T. Thorn, T. Lyon, and A. Dahl. 2013b. Post-Construction Monitoring Results, Red Hills Wind Farm, Roger Mills and Custer Counties, Oklahoma. Final Report: March 2012 to March 2013. Prepared for Acciona Wind Energy, Chicago, Illinois. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota. June 12, 2013.

Derby, C., J. Ritzert, and K. Bay. 2010g. Bird and Bat Fatality Study, Grand Ridge Wind Resource Area, Lasalle County, Illinois. January 2009 - January 2010. Prepared for Grand Ridge Energy LLC, Chicago, Illinois. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota. July 13, 2010. Revised January 2011.

Downes, S. and R. Gritski. 2012a. Harvest Wind Project Wildlife Monitoring Report: January 2010 – January 2012. Prepared for Harvest Wind Project, Roosevelt, Washington. Prepared by Northwest Wildlife Consultants, Inc., Pendleton, Oregon May 1, 2012.

Downes, S. and R. Gritski. 2012b. White Creek Wind I Wildlife Monitoring Report: November 2007 - November 2011. Prepared for White Creek Wind I, LLC, Roosevelt, Washington. Prepared by Northwest Wildlife Consultants, Inc., Pendleton, Oregon May 1, 2012.

Endangered Species Act (ESA). 1973. 16 United States Code (USC) § 1531-1544, Public Law (PL) 93-205, December 28, 1973, as amended, PL 100-478 [16 USC 1531 *et seq.*]; 50 Code of Federal Regulations (CFR) 402.

Enk, T., K. Bay, M. Sonnenberg, J. Baker, M. Kesterke, J. R. Boehrs, and A. Palochak. 2010. Biglow Canyon Wind Farm Phase I Post-Construction Avian and Bat Monitoring Second Annual Report, Sherman County, Oregon. January 26, 2009 - December 11, 2009. Prepared for Portland General Electric Company, Portland, Oregon. Prepared by Western EcoSystems Technology, Inc.(WEST) Cheyenne, Wyoming, and Walla Walla, Washington. April 2010.

Enk, T., K. Bay, M. Sonnenberg, and J. R. Boehrs. 2012a. Year 1 Avian and Bat Monitoring Report: Biglow Canyon Wind Farm Phase III, Sherman County, Oregon. September 13, 2010 - September 9, 2011. Prepared for Portland General Electric Company, Portland, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming, and Walla Walla, Washington. April 24, 2012.

Enk, T., K. Bay, M. Sonnenberg, and J. R. Boehrs. 2012b. Year 2 Avian and Bat Monitoring Report: Biglow Canyon Wind Farm Phase II, Sherman County, Oregon. September 13, 2010 - September 12, 2011. Prepared for Portland General Electric Company, Portland, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming, and Walla Walla, Washington. April 23, 2012.

Enk, T., K. Bay, M. Sonnenberg, J. Flaig, J. R. Boehrs, and A. Palochak. 2011a. Year 1 Post-Construction Avian and Bat Monitoring Report: Biglow Canyon Wind Farm Phase II, Sherman County, Oregon. September 10, 2009 - September 12, 2010. Prepared for Portland General Electric Company, Portland, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming, and Walla Walla, Washington. January 7, 2011.

Enk, T., C. Derby, K. Bay, and M. Sonnenberg. 2011b. 2010 Post-Construction Fatality Monitoring Report, Elkhorn Valley Wind Farm, Union County, Oregon. January – December 2010. Prepared for EDP Renewables, North America LLC, Houston, Texas. Prepared by Western EcoSystems Technology, Inc. (WEST), Walla Walla, Washington, and Cheyenne, Wyoming. December 8, 2011.

Enz, T. and K. Bay. 2010. Post-Construction Avian and Bat Fatality Monitoring Study, Tuolumne Wind Project, Klickitat County, Washington. Final Report: April 20, 2009 - April 7, 2010. Prepared for Turlock Irrigation District, Turlock, California. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. July 6, 2010.

Enz, T. and K. Bay. 2011. Post-Construction Monitoring at the Linden Ranch Wind Farm, Klickitat County, Washington. Final Report: June 30, 2010 - July 17, 2011. Prepared for EnXco. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. November 10, 2011.

Enz, T., K. Bay, S. Nomani, and M. Kesterke. 2011. Bird and Bat Fatality Monitoring Study, Windy Flats and Windy Point II Wind Energy Projects, Klickitat County, Washington. Final Report: February 1, 2010 - January 14, 2011. Prepared for Windy Flats Partners, LLC, Goldendale, Washington. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. August 19, 2011.

Enz, T., K. Bay, M. Sonnenberg, and A. Palochak. 2012. Post-Construction Monitoring Studies for the Combine Hills Turbine Ranch, Umatilla County, Oregon. Final Report: January 7 - December 2, 2011. Prepared for Eurus Energy America Corporation, San Diego, California. Prepared by Western EcoSystems Technology, Inc. (WEST), Walla Walla, Washington.

Erickson, W. P. 2006. Objectives, Uncertainties and Biases in Mortality Studies at Wind Facilities. Paper presented at the NWCC Research Meeting VI, November 2006. San Antonio, Texas.

Erickson, W. P., J. Jeffrey, K. Kronner, and K. Bay. 2004. Stateline Wind Project Wildlife Monitoring Annual Report. July 2001 - December 2003. Technical report peer-reviewed by and submitted to FPL Energy, the Oregon Energy Facility Siting Council, and the Stateline Technical Advisory Committee. Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming, and Northwest Wildlife Consultants, Inc. (NWC), Pendleton, Oregon. December 2004.

Erickson, W. P., J. Jeffrey, and V. K. Poulton. 2008. Avian and Bat Monitoring: Year 1 Report. Puget Sound Energy Wild Horse Wind Project, Kittitas County, Washington. Prepared for Puget Sound Energy, Ellensburg, Washington, by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. January 2008.

Erickson, W. P., G. D. Johnson, M. D. Strickland, and K. Kronner. 2000. Avian and Bat Mortality Associated with the Vansycle Wind Project, Umatilla County, Oregon. Technical Report prepared by WEST, Inc., for Umatilla County Department of Resource Services and Development, Pendleton, Oregon. 21 pp.

Erickson, W. P., G. D. Johnson, and D. P. Young, Jr. 2005. Summary and Causes of Bird Mortality from Anthropogenic Causes with an Emphasis on Collisions. USDA Forest Service Technical Report PSW-GTR-191.

Erickson, W. P., K. Kronner, and K. J. Bay. 2007. Stateline 2 Wind Project Wildlife Monitoring Report, January - December 2006. Technical report submitted to FPL Energy, the Oregon Energy Facility Siting Council, and the Stateline Technical Advisory Committee.

Erickson, W. P., K. Kronner, and R. Gritski. 2003. Nine Canyon Wind Power Project Avian and Bat Monitoring Report. September 2002 – August 2003. Prepared for the Nine Canyon Technical Advisory Committee and Energy Northwest by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming, and Northwest Wildlife Consultants (NWC), Pendleton, Oregon. October 2003. http://www.west-inc.com/reports/nine_canyon_monitoring_final.pdf

Fiedler, J. K. 2004. Assessment of Bat Mortality and Activity at Buffalo Mountain Windfarm, Eastern Tennessee. Thesis. University of Tennessee, Knoxville, Tennessee. August, 2004. http://www.tva.gov/environment/bmw_report/bat_mortality_bmw.pdf

Fiedler, J. K., T. H. Henry, R. D. Tankersley, and C. P. Nicholson. 2007. Results of Bat and Bird Mortality Monitoring at the Expanded Buffalo Mountain Windfarm, 2005. Tennessee Valley Authority. June 28, 2007.

Gelman, A. J.B.Carlin, H.S. Stern. D.B.Dunson, A. Vehtari, and D.B. Rubin. 2013. Bayesian Data Analysis. 3rd edition. Chapman and Hall.

Good, R. E., W. P. Erickson, A. Merrill, S. Simon, K. Murray, K. Bay, and C. Fritchman. 2011. Bat Monitoring Studies at the Fowler Ridge Wind Energy Facility, Benton County, Indiana: April 13 - October 15, 2010. Prepared for Fowler Ridge Wind Farm. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. January 28, 2011.

Good, R. E., A. Merrill, S. Simon, K. Murray, and K. Bay. 2012. Bat Monitoring Studies at the Fowler Ridge Wind Farm, Benton County, Indiana: April 1 - October 31, 2011. Prepared for the Fowler Ridge Wind Farm. Prepared by Western EcoSystems Technology, Inc. (WEST), Bloomington, Indiana. January 31, 2012.

Good, R. E., M. Sonnenburg, and S. Simon. 2013. Bat Evaluation Monitoring Studies at the Fowler Ridge Wind Farm, Benton County, Indiana: August 1 - October 15, 2012. Prepared for the Fowler Ridge Wind Farm. Prepared by Western EcoSystems Technology, Inc. (WEST), Bloomington, Indiana. January 31, 2013.

Gritski, R., S. Downes, and K. Kronner. 2010. Klondike III (Phase 1) Wind Power Project Wildlife Monitoring: October 2007-October 2009. Prepared for Iberdrola Renewables, Inc. (IRI), Portland, Oregon, for Klondike Wind Power III LLC. Prepared by Northwest Wildlife Consultants, Inc. (NWC), Pendleton, Oregon. April 21, 2010 (Updated September 2010). Available online at: http://www.oregon.gov/energy/Siting/docs/KWP/KWPWildlifeReport091210.pdf

Gritski, R., S. Downes, and K. Kronner. 2011. Klondike IIIa (Phase 2) Wind Power Project Wildlife Monitoring: August 2008 - August 2010. Updated Final. Prepared for Iberdrola Renewables, Inc. (IRI), Portland, Oregon, for Klondike Wind Power III LLC. Prepared by Northwest Wildlife Consultants, Inc. (NWC), Pendleton, Oregon. Updated April 2011. Available online at: http://www.oregon.gov/energy/Siting/docs/KWP/KWPWildlifeReport042711.pdf

Gritski, R. and K. Kronner. 2010a. Hay Canyon Wind Power Project Wildlife Monitoring Study: May 2009 - May 2010. Prepared for Iberdrola Renewables, Inc. (IRI), Hay Canyon Wind Power Project LLC. Prepared by Northwest Wildlife Consultants, Inc. (NWC), Pendleton, Oregon. September 20, 2010.

Gritski, R. and K. Kronner. 2010b. Pebble Springs Wind Power Project Wildlife Monitoring Study: January 2009 - January 2010. Prepared for Iberdrola Renewables, Inc. (IRI), and the Pebble Springs Advisory Committee. Prepared by Northwest Wildlife Consultants, Inc. (NWC), Pendleton, Oregon. April 20, 2010.

Gritski, R., K. Kronner, and S. Downes. 2008. Leaning Juniper Wind Power Project, 2006– 2008. Wildlife Monitoring Final Report. Prepared for PacifiCorp Energy, Portland, Oregon. Prepared by Northwest Wildlife Consultants, Inc. (NWC), Pendleton, Oregon. December 30, 2008.

Grodsky, S. M. and D. Drake. 2011. Assessing Bird and Bat Mortality at the Forward Energy Center. Final Report. Public Service Commission (PSC) of Wisconsin. PSC REF#:152052. Prepared for Forward Energy LLC. Prepared by Department of Forest and Wildlife Ecology, University of Wisconsin-Madison, Madison, Wisconsin. August 2011.

Gruver, J. 2002. Assessment of Bat Community Structure and Roosting Habitat Preferences for the Hoary Bat (*Lasiurus cinereus*) near Foote Creek Rim, Wyoming. Thesis. University of Wyoming, Laramie, Wyoming. 149 pp.

Gruver, J. 2008. Bat Acoustic Studies for the Blue Sky Green Field Wind Project, Fond Du Lac County, Wisconsin. Final Report: July 24 - October 29, 2007. Prepared for We Energies, Milwaukee, Wisconsin. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. February 26, 2008.

Gruver, J., K. Bay, M. Kesterke, W. Erickson, K. Murray, and M. Ritzert. 2011. A Summary of Bat Studies and Fatalities from Wind Energy Facilities in the United States with an Emphasis on the Midwest. Oral Presentation (*invited*) given to the 2nd Joint Meeting Northeastern Bat Working Group, Midwest Bat Working Group, Southeastern Bat Diversity Network, and 21st Colloquium on the Conservation of Mammals in the Eastern United States, Louisville, Kentucky. February 23-25, 2011.

Gruver, J., M. Sonnenberg, K. Bay, and W. Erickson. 2009. Post-Construction Bat and Bird Fatality Study at the Blue Sky Green Field Wind Energy Center, Fond Du Lac County, Wisconsin July 21 - October 31, 2008 and March 15 - June 4, 2009. Unpublished report prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. December 17, 2009.

Howe, R. W., W. Evans, and A. T. Wolf. 2002. Effects of Wind Turbines on Birds and Bats in Northeastern Wisconsin. Prepared by University of Wisconsin-Green Bay, for Wisconsin Public Service Corporation and Madison Gas and Electric Company, Madison, Wisconsin. November 21, 2002. 104 pp.

Huso, M. M. P. 2011. An Estimator of Mortality from Observed Carcasses. Environmetrics 21(3): 318-329. doi: 310.1002/env.1052.

Jacques Whitford Stantec Limited (Jacques Whitford). 2009. Ripley Wind Power Project Postconstruction Monitoring Report. Project No. 1037529.01. Report to Suncor Energy Products Inc., Calgary, Alberta, and Acciona Energy Products Inc., Calgary, Alberta. Prepared for the Ripley Wind Power Project Post-Construction Monitoring Program. Prepared by Jacques Whitford, Markham, Ontario. April 30, 2009. www.jacqueswhitford.com

Jain, A. 2005. Bird and Bat Behavior and Mortality at a Northern Iowa Windfarm. Thesis. Iowa State University, Ames, Iowa.

Jain, A., P. Kerlinger, R. Curry, and L. Slobodnik. 2007. Annual Report for the Maple Ridge Wind Power Project: Post-Construction Bird and Bat Fatality Study – 2006. Final Report. Prepared for PPM Energy and Horizon Energy and Technical Advisory Committee (TAC) for the Maple Ridge Project Study.

Jain, A., P. Kerlinger, R. Curry, and L. Slobodnik. 2009a. Annual Report for the Maple Ridge Wind Power Project: Post-Construction Bird and Bat Fatality Study - 2007. Final report prepared for PPM Energy and Horizon Energy and Technical Advisory Committee (TAC) for the Maple Ridge Project Study. May 6, 2009.

Jain, A., P. Kerlinger, R. Curry, L. Slobodnik, A. Fuerst, and C. Hansen. 2009b. Annual Report for the Noble Ellenburg Windpark, LLC, Postconstruction Bird and Bat Fatality Study - 2008. Prepared for Noble Environmental Power, LLC by Curry and Kerlinger, LLC. April 13, 2009.

Jain, A., P. Kerlinger, R. Curry, L. Slobodnik, J. Histed, and J. Meacham. 2009c. Annual Report for the Noble Clinton Windpark, LLC, Postconstruction Bird and Bat Fatality Study - 2008. Prepared for Noble Environmental Power, LLC by Curry and Kerlinger, LLC. April 13, 2009.

Jain, A., P. Kerlinger, R. Curry, L. Slobodnik, and M. Lehman. 2009d. Maple Ridge Wind Power Avian and Bat Fatality Study Report - 2008. Annual Report for the Maple Ridge Wind Power Project, Post-construction Bird and Bat Fatality Study - 2008. Prepared for Iberdrola Renewables, Inc, Horizon Energy, and the Technical Advisory Committee (TAC) for the Maple Ridge Project Study. Prepared by Curry and Kerlinger, LLC. May 14, 2009.

Jain, A., P. Kerlinger, R. Curry, L. Slobodnik, J. Quant, and D. Pursell. 2009e. Annual Report for the Noble Bliss Windpark, LLC, Postconstruction Bird and Bat Fatality Study - 2008. Prepared for Noble Environmental Power, LLC by Curry and Kerlinger, LLC. April 13, 2009.

Jain, A., P. Kerlinger, L. Slobodnik, R. Curry, A. Fuerst, and A. Harte. 2010a. Annual Report for the Noble Bliss Windpark, LLC: Postconstruction Bird and Bat Fatality Study - 2009. Prepared for Noble Environmental Power, LLC. Prepared by Curry and Kerlinger, LLC, Cape May, New Jersey. March 9, 2010.

Jain, A., P. Kerlinger, L. Slobodnik, R. Curry, and A. Harte. 2011a. Annual Report for the Noble Wethersfield Windpark, LLC: Postconstruction Bird and Bat Fatality Study - 2010. Prepared for Noble Environmental Power, LLC. Prepared by Curry and Kerlinger, LLC, Cape May, New Jersey. January 22, 2011.

Jain, A., P. Kerlinger, L. Slobodnik, R. Curry, and K. Russell. 2010b. Annual Report for the Noble Clinton Windpark, LLC: Postconstruction Bird and Bat Fatality Study - 2009. Prepared for Noble Environmental Power, LLC. Prepared by Curry and Kerlinger, LLC, Cape May, New Jersey. March 9, 2010.

Jain, A., P. Kerlinger, L. Slobodnik, R. Curry, and K. Russell. 2010c. Annual Report for the Noble Ellenburg Windpark, LLC: Postconstruction Bird and Bat Fatality Study - 2009. Prepared for Noble Environmental Power, LLC. Prepared by Curry and Kerlinger, LLC, Cape May, New Jersey. March 14, 2010.

Jain, A., P. Kerlinger, L. Slobodnik, R. Curry, and K. Russell. 2011b. Annual Report for the Noble Altona Windpark, LLC: Postconstruction Bird and Bat Fatality Study - 2010. Prepared for Noble Environmental Power, LLC. Prepared by Curry and Kerlinger, LLC, Cape May, New Jersey. January 22, 2011.

Jain, A., P. Kerlinger, L. Slobodnik, R. Curry, and K. Russell. 2011c. Annual Report for the Noble Chateaugay Windpark, LLC: Postconstruction Bird and Bat Fatality Study - 2010. Prepared for Noble Environmental Power, LLC. Prepared by Curry and Kerlinger, LLC, Cape May, New Jersey. January 22, 2011.

Jeffrey, J. D., K. Bay, W. P. Erickson, M. Sonneberg, J. Baker, M. Kesterke, J. R. Boehrs, and A. Palochak. 2009a. Portland General Electric Biglow Canyon Wind Farm Phase I Post-Construction Avian and Bat Monitoring First Annual Report, Sherman County, Oregon. January 2008 - December 2008. Technical report prepared for Portland General Electric Company, Portland, Oregon. Prepared by Western EcoSystems Technology (WEST) Inc., Cheyenne, Wyoming, and Walla Walla, Washington. April 29, 2009.

Jeffrey, J. D., W. P. Erickson, K. Bay, M. Sonneberg, J. Baker, J. R. Boehrs, and A. Palochak. 2009b. Horizon Wind Energy, Elkhorn Valley Wind Project, Post-Construction Avian and Bat Monitoring, First Annual Report, January-December 2008. Technical report prepared for Telocaset Wind Power Partners, a subsidiary of Horizon Wind Energy, Portland, Oregon. Prepared by Western EcoSystems Technology, Inc., Cheyenne, Wyoming, and Walla Walla, Washington. May 4, 2009.

Johnson, G. D. 2005. A Review of Bat Mortality at Wind-Energy Developments in the United States. Bat Research News 46(2): 45-49.

Johnson, G. D., W. P. Erickson, M. D. Strickland, M. F. Shepherd, and D. A. Shepherd. 2000. Avian Monitoring Studies at the Buffalo Ridge Wind Resource Area, Minnesota: Results of a 4-Year Study. Final report prepared for Northern States Power Company, Minneapolis, Minnesota, by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. September 22, 2000. 212 pp. http://www.west-inc.com

Johnson, G. D., W. P. Erickson, M. D. Strickland, M. F. Shepherd, D. A. Shepherd, and S. A. Sarappo. 2003. Mortality of Bats at a Large-Scale Wind Power Development at Buffalo Ridge, Minnesota. The American Midland Naturalist 150: 332-342.

Johnson, G. D., M. K. Perlik, W. P. Erickson, and M. D. Strickland. 2004. Bat Activity, Composition and Collision Mortality at a Large Wind Plant in Minnesota. Wildlife Society Bulletin 32(4): 1278-1288.

Kerlinger, P., R. Curry, L. Culp, A. Hasch, and A. Jain. 2009. Post-Construction Avian Monitoring Study for the Shiloh I Wind Power Project, Solano County, California. Final Report: October 2009. Third Year Report (Revised 2010). Prepared for Iberdrola Renewables, Inc. (IRI). Prepared by Curry and Kerlinger, LLC., McLean, Virginia.

Kerlinger, P., R. Curry, L. Culp, A. Hasch, and A. Jain. 2010. Post-Construction Avian Monitoring Study for the Shiloh II Wind Power Project, Solano County, California. Year One Report. Prepared for enXco Development Inc. Prepared by Curry and Kerlinger, LLC, McLean, Virginia. September 2010.

Kerlinger, P., R. Curry, L. Culp, A. Jain, C. Wilkerson, B. Fischer, and A. Hasch. 2006. Post-Construction Avian and Bat Fatality Monitoring for the High Winds Wind Power Project, Solano County, California: Two Year Report. Prepared for High Winds LLC, FPL Energy by Curry and Kerlinger, LLC. April 2006.

Kerlinger, P., R. Curry, A. Hasch, and J. Guarnaccia. 2007. Migratory Bird and Bat Monitoring Study at the Crescent Ridge Wind Power Project, Bureau County, Illinois: September 2005 - August 2006. Final draft prepared for Orrick Herrington and Sutcliffe, LLP. May 2007.

Kerns, J. and P. Kerlinger. 2004. A Study of Bird and Bat Collisions at the Mountaineer Wind Energy Facility, Tucker County, West Virginia: Annual Report for 2003. Prepared for FPL Energy and the Mountaineer Wind Energy Center Technical Review Committee. February 14, 2004. Technical report prepared by Curry and Kerlinger, LLC., for FPL Energy and Mountaineer Wind Energy Center Technical Review Committee. Curry and Kerlinger, LLC. 39 pp. http://www.wvhighlands.org/Birds/MountaineerFinalAvianRpt-%203-15-04PKJK.pdf

Kronner, K., R. Gritski, and S. Downes. 2008. Big Horn Wind Power Project Wildlife Fatality Monitoring Study: 2006-2007. Final report prepared for PPM Energy and the Big Horn Wind Project Technical Advisory Committee by Northwest Wildlife Consultants, Inc. (NWC), Mid-Columbia Field Office, Goldendale, Washington. June 1, 2008.

Manly, B. F. J. 1997. Randomization, Bootstrap, and Monte Carlo Methods in Biology. 2nd Edition. Chapman and Hall, London.

Minnesota Department of Natural Resources (MDNR). 2014. Ecological Classification System. Available at: http://www.dnr.state.mn.us/ecs/index.html

Natural Resource Solutions Inc. (NRSI). 2011. Harrow Wind Farm 2010 Post-Construction Monitoring Report. Project No. 0953. Prepared for International Power Canada, Inc., Markham, Ontario. Prepared by NRSI. August 2011.

Nicholson, C. P., J. R.D. Tankersley, J. K. Fiedler, and N. S. Nicholas. 2005. Assessment and Prediction of Bird and Bat Mortality at Wind Energy Facilities in the Southeastern United States. Final Report. Tennessee Valley Authority, Knoxville, Tennessee.

Normandeau Associates, Inc. 2010. Stetson Mountain II Wind Project Year 1 Post-Construction Avian and Bat Mortality Monitoring Study, T8 R4 Nbpp, Maine. Prepared for First Wind, LLC, Portland, Maine. Prepared by Normandeau Associates, Inc., Falmouth, Maine. December 2, 2010.

Normandeau Associates, Inc. 2011. Year 3 Post- Construction Avian and Bat Casualty Monitoring at the Stetson I Wind Farm, T8 R4 Nbpp, Maine. Prepared for First Wind Energy, LLC, Portland, Maine. Prepared by Normandeau Associates, Inc., Falmouth, Maine. December 2011.

Northwest Wildlife Consultants, Inc. (NWC) and Western EcoSystems Technology, Inc. (WEST). 2007. Avian and Bat Monitoring Report for the Klondike II Wind Power Project. Sherman County, Oregon. Prepared for PPM Energy, Portland, Oregon. Managed and conducted by NWC, Pendleton, Oregon. Analysis conducted by WEST, Cheyenne, Wyoming. July 17, 2007.

Poulton, V. and W. P. Erickson. 2010. Post-Construction Bat and Bird Fatality Study, Judith Gap Wind Farm, Wheatland County, Montana. Final Report: Results from June–October 2009 Study and Comparison with 2006-2007 Study. Prepared for Judith Gap Energy, LLC. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. March 2010.

Reynolds, D. S. 2010a. Post-Construction Acoustic Monitoring, 2009 Sampling Period: Noble Clinton Windpark, Clinton County, New York. Prepared for Noble Environmental Power, LLC, Essex, Connecticut. Prepared by North East Ecological Services, Bow, New Hampshire. April 6, 2010.

Reynolds, D. S. 2010b. Post-Construction Acoustic Monitoring, 2009 Sampling Period: Noble Ellenburg Windpark, Clinton County, New York. Prepared for Noble Environmental Power, LLC, Essex, Connecticut. Prepared by North East Ecological Services, Bow, New Hampshire. April 6, 2010.

Shoenfeld, P. 2004. Suggestions Regarding Avian Mortality Extrapolation. Technical memo provided to FPL Energy. West Virginia Highlands Conservancy, HC70, Box 553, Davis, West Virginia, 26260.

Smallwood, K. S., D. A. Bell, S. A. Snyder, and J. E. DiDonato. 2010. Novel Scavenger Removal Trials Increase Wind Turbine-Caused Avian Fatality Estimates. Journal of Wildlife Management 74: 1089-1097.

Solick, D., A. Krause, A. Chatfield, and W. P. Erickson. 2010. Bat Acoustic Studies for the Alta East Wind Resource Area, Kern County, California. Final Report: July 7, 2009 – July 9, 2010. Prepared for CH2M HILL, Oakland, California. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. October 15, 2010.

Stantec Consulting, Inc. (Stantec). 2008. 2007 Spring, Summer, and Fall Post-Construction Bird and Bat Mortality Study at the Mars Hill Wind Farm, Maine. Prepared for UPC Wind Management, LLC, Cumberland, Maine. Prepared by Stantec (formerly Woodlot Alternatives, Inc.), Topsham, Maine. January 2008.

Stantec Consulting, Inc. (Stantec). 2009a. Post-Construction Monitoring at the Mars Hill Wind Farm, Maine - Year 2, 2008. Prepared for First Wind Management, LLC, Portland, Maine. Prepared by Stantec Consulting, Topsham, Maine. January 2009.

Stantec Consulting, Inc. (Stantec). 2009b. Post-Construction Monitoring at the Munnsville Wind Farm, New York: 2008. Prepared for E.ON Climate and Renewables, Austin, Texas. Prepared by Stantec Consulting, Topsham, Maine. January 2009.

Stantec Consulting, Inc. (Stantec). 2009c. Stetson I Mountain Wind Project: Year 1 Post-Construction Monitoring Report, 2009 for the Stetson Mountain Wind Project in Penobscot and Washington Counties, Maine. Prepared for First Wind Management, LLC. Portland, Maine. Prepared by Stantec, Topsham, Maine. January 2009.

Stantec Consulting, Inc. (Stantec). 2010. Cohocton and Dutch Hill Wind Farms Year 1 Post-Construction Monitoring Report, 2009, for the Cohocton and Dutch Hill Wind Farms in Cohocton, New York. Prepared for Canandaigua Power Partners, LLC and Canandaigua Power Partners II, LLC, Portland, Maine. Prepared by Stantec, Topsham, Maine. January 2010.

Stantec Consulting, Inc. (Stantec). 2011. Cohocton and Dutch Hill Wind Farms Year 2 Post-Construction Monitoring Report, 2010, for the Cohocton and Dutch Hill Wind Farms in Cohocton, New York. Prepared for Canandaigua Power Partners, LLC, and Canandaigua Power Partners II, LLC, Portland, Maine. Prepared by Stantec, Topsham, Maine. October 2011.

Stantec Consulting, Inc. (Stantec). 2012. 2011 Post-Construction Monitoring Report, Kibby Wind Power Project, Franklin County, Maine. Prepared for TransCanada Hydro Northeast, Inc., North Walpole, New Hampshire. Prepared by Stantec, Topsham, Maine. March 2012.

Stantec Consulting Ltd. (Stantec Ltd.). 2010. Wolfe Island Ecopower Centre Post-Construction Followup Plan. Bird and Bat Resources Monitoring Report No. 2: July - December 2009. File No. 160960494. Prepared for TransAlta Corporation's wholly owned subsidiary, Canadian Renewable Energy Corporation. Prepared by Stantec Ltd., Guelph, Ontario. May 2010.

Stantec Consulting Ltd. (Stantec Ltd.). 2011. Wolfe Island Wind Plant Post-Construction Followup Plan. Bird and Bat Resources Monitoring Report No. 4: July - December 2010. File No. 160960494. Prepared for TransAlta Corporation's wholly owned subsidiary, Canadian Renewable Energy Corporation. Prepared by Stantec Consulting Ltd., Guelph, Ontario. July 2011.

Stantec Consulting Ltd. (Stantec Ltd.). 2012. Wolfe Island Wind Plant Post-Construction Follow-up Plan. Bird and Bat Resources Monitoring Report No. 6: July-December 2011. File No. 160960494. Prepared for TransAlta Corporation's wholly owned subsidiary, Canadian Renewable Energy Corporation. Prepared by Stantec Consulting Ltd., Guelph, Ontario. July 2012.

Stantec Consulting Services, Inc. (Stantec Consulting Services). 2012. Post-Construction Monitoring, Summer 2011 - Spring 2012, Year 1 Annual Report: Kittitas Valley Wind Power Project, Cle Elum, Washington. Prepared for Sagebrush Power Partners, LLC, Houston, Texas. Prepared by Stantec, Salt Lake City, Utah.

Thompson, J. and K. Bay. 2012. Post-Construction Fatality Surveys for the Dry Lake II Wind Project: February 2011 – February 2012. Prepared for Iberdrola Renewables, LLC, Portland, Oregon. Prepared by Western Ecosystems Technology, Inc. (WEST), Cheyenne, Wyoming. June 6, 2012.

Thompson, J., D. Solick, and K. Bay. 2011. Post-Construction Fatality Surveys for the Dry Lake Phase I Wind Project. Iberdrola Renewables: September 2009 - November 2010. Prepared for Iberdrola Renewables, Portland, Oregon. Prepared by Western Ecosystems Technology, Inc. (WEST), Cheyenne, Wyoming. February 10, 2011.

Tidhar, D., L. McManus, Z. Courage, and W. L. Tidhar. 2012a. 2010 Post-Construction Fatality Monitoring Study and Bat Acoustic Study for the High Sheldon Wind Farm, Wyoming County, New York. Final Report: April 15 - November 15, 2010. Prepared for High Sheldon Wind Farm, Sheldon Energy LLC, Chicago, Illinois. Prepared by Western EcoSystems Technology, Inc. (WEST), Waterbury, Vermont. April 15, 2012.

Tidhar, D., L. McManus, D. Solick, Z. Courage, and K. Bay. 2012b. 2011 Post-Construction Fatality Monitoring Study and Bat Acoustic Study for the High Sheldon Wind Farm, Wyoming County, New York. Final Report: April 15 - November 15, 2011. Prepared for High Sheldon Wind Farm, Sheldon Energy LLC, Chicago, Illinois. Prepared by Western EcoSystems Technology, Inc. (WEST), Waterbury, Vermont. April 25, 2012.

Tidhar, D., M. Sonnenberg, and D.P. Young, Jr. 2013. 2012 Post-Construction Carcass Monitoring Study for the Beech Ridge Wind Farm, Greenbrier County, West Virginia. Final Report: April 1 - October 28, 2012. Prepared for Beech Ridge Wind Farm, Beech Ridge Energy, LLC, Chicago, Illinois. Prepared by Western EcoSystems Technology, Inc. (WEST), NE/Mid-Atlantic Branch, Waterbury, Vermont. January 18, 2013.

Tidhar, D., W. Tidhar, and M. Sonnenberg. 2010. Post-Construction Fatality Surveys for Lempster Wind Project, Iberdrola Renewables. Prepared for Lempster Wind, LLC, Lempster Wind Technical Advisory Committee, and Iberdrola Renewables, Inc. Prepared by Western EcoSystems Technology Inc. (WEST), Waterbury, Vermont. September 30, 2010.

Tidhar, D., W. L. Tidhar, L. McManus, and Z. Courage. 2011. 2010 Post-Construction Fatality Surveys for the Lempster Wind Project, Lempster, New Hampshire. Prepared for Iberdrola Renewables, Inc. and the Lempster Wind Technical Committee. Prepared by Western EcoSystems Technology, Inc., Waterbury, Vermont. May 18, 2011.

Tierney, R. 2007. Buffalo Gap I Wind Farm Avian Mortality Study: February 2006-January 2007. Final Survey Report. Prepared for AES SeaWest, Inc. TRC, Albuquerque, New Mexico.TRC Report No. 110766-C-01. May 2007.

Tierney, R. 2009. Buffalo Gap 2 Wind Farm Avian Mortality Study: July 2007 - December 2008. Final Survey Report. Submitted by TRC, Albuquerque, New Mexico. TRC Report No. 151143-B-01. June 2009.

TRC Environmental Corporation. 2008. Post-Construction Avian and Bat Fatality Monitoring and Grassland Bird Displacement Surveys at the Judith Gap Wind Energy Project, Wheatland County, Montana. Prepared for Judith Gap Energy, LLC, Chicago, Illinois. TRC Environmental Corporation, Laramie, Wyoming. TRC Project 51883-01 (112416). January 2008. http://www.newwest.net/pdfs/AvianBatFatalityMonitoring.pdf

URS Corporation. 2010a. Final Goodnoe Hills Wind Project Avian Mortality Monitoring Report. Prepared for PacifiCorp, Salt Lake City, Utah. Prepared by URS Corporation, Seattle, Washington. March 16, 2010.

URS Corporation. 2010b. Final Marengo I Wind Project Year One Avian Mortality Monitoring Report. Prepared for PacifiCorp, Salt Lake City, Utah. Prepared by URS Corporation, Seattle, Washington. March 22, 2010.

URS Corporation. 2010c. Final Marengo II Wind Project Year One Avian Mortality Monitoring Report. Prepared for PacifiCorp, Salt Lake City, Utah. Prepared by URS Corporation, Seattle, Washington. March 22, 2010.

US Fish and Wildlife Service (USFWS). 2013. Endangered and Threatened Wildlife and Plants; 12-Month Finding on a Petition to List the Eastern Small-Footed Bat and the Northern Long-Eared Bat as Endangered or Threatened Species; Listing the Northern Long-Eared Bat as an Endangered Species. Docket No. FWS–R5–ES–2011–0024. October 2, 2013.

US Geological Survey (USGS). 2013. The National Map/US Topo. Last updated January 2, 2013. Homepage available at: http://nationalmap.gov/ustopo/index.html

Ventus Environmental Solutions (Ventus). 2012. Vantage Wind Energy Center Avian and Bat Monitoring Study: March 2011- March 2012. Prepared for Vantage Wind Energy, LLC, Chicago, Illinois. Prepared by Ventus, Portland, Oregon. May 16, 2012.

Watt, M. A. and D. Drake. 2011. Assessing Bat Use at the Forward Energy Center. Final Report. PSC REF#:152051. Public Service Commission of Wisconsin. Prepared for Forward Energy LLC. Prepared by Department of Forest and Wildlife Ecology, University of Wisconsin-Madison, Madison, Wisconsin. August 2011.

Western EcoSystems Technology, Inc. (WEST). 2006. Diablo Winds Wildlife Monitoring Progress Report, March 2005 - February 2006. Technical report submitted to FPL Energy and Alameda County California. WEST. Cheyenne, Wyoming.

Western EcoSystems Technology, Inc. (WEST). 2008. Diablo Winds Wildlife Monitoring Progress Report: March 2005 – February 2007. Prepared by WEST, Cheyenne, Wyoming. August 2008.

Western EcoSystems Technology, Inc. (WEST). 2011. Post-Construction Fatality Surveys for the Barton Chapel Wind Project: Iberdrola Renewables. Version: July 2011. Iberdrola Renewables, Portland, Oregon.

Young, D.P. Jr., K. Bay, S. Nomani, and W. Tidhar. 2009a. Nedpower Mount Storm Wind Energy Facility, Post-Construction Avian and Bat Monitoring: March - June 2009. Prepared for NedPower Mount Storm, LLC, Houston, Texas. Prepared by Western EcoSystems Technology (WEST), Inc., Cheyenne, Wyoming. August 17, 2009.

Young, D.P. Jr., K. Bay, S. Nomani, and W. Tidhar. 2010a. Nedpower Mount Storm Wind Energy Facility, Post-Construction Avian and Bat Monitoring: April - July 2010. Prepared for NedPower Mount Storm, LLC, Houston, Texas. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. August 27, 2010.

Young, D.P. Jr., K. Bay, S. Nomani, and W. Tidhar. 2010b. Nedpower Mount Storm Wind Energy Facility, Post-Construction Avian and Bat Monitoring: July - October 2009. Prepared for NedPower Mount Storm, LLC, Houston, Texas. Prepared by Western EcoSystems Technology (WEST), Inc., Cheyenne, Wyoming. February 12, 2010.

Young, D.P. Jr., W. P. Erickson, K. Bay, S. Nomani, and W. Tidhar. 2009b. Mount Storm Wind Energy Facility, Phase 1 Post-Construction Avian and Bat Monitoring, July - October 2008. Prepared for NedPower Mount Storm, LLC, Houston, Texas. Prepared by Western EcoSystems Technology (WEST), Inc., Cheyenne, Wyoming. February 17, 2009.

Young, D.P. Jr., W. P. Erickson, R. E. Good, M. D. Strickland, and G. D. Johnson. 2003a. Avian and Bat Mortality Associated with the Initial Phase of the Foote Creek Rim Windpower Project, Carbon County, Wyoming, Final Report, November 1998 - June 2002. Prepared for Pacificorp, Inc. Portland, Oregon, SeaWest Windpower Inc. San Diego, California, and Bureau of Land Management, Rawlins District Office, Rawlins, Wyoming.

Young, D.P. Jr., W. P. Erickson, J. Jeffrey, and V. K. Poulton. 2007. Puget Sound Energy Hopkins Ridge Wind Project Phase 1 Post-Construction Avian and Bat Monitoring First Annual Report, January - December 2006. Technical report for Puget Sound Energy, Dayton, Washington and Hopkins Ridge Wind Project Technical Advisory Committee, Columbia County, Washington. Western EcoSystems Technology, Inc. (WEST) Cheyenne, Wyoming, and Walla Walla, Washington. 25 pp.

Young, D.P. Jr., W. P. Erickson, M. D. Strickland, R. E. Good, and K. J. Sernka. 2003b. Comparison of Avian Responses to UV-Light-Reflective Paint on Wind Turbines. Subcontract Report July 1999 – December 2000. NREL/SR-500-32840. Prepared for National Renewable Energy Laboratory, Golden, Colorado, by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. Foote Creek Rim Wind Plant, Carbon County, Wyoming. January 2003. http://www.west-inc.com

Young, D.P. Jr., J. Jeffrey, W. P. Erickson, K. Bay, V. K. Poulton, K. Kronner, R. Gritski, and J. Baker. 2006. Eurus Combine Hills Turbine Ranch. Phase 1 Post Construction Wildlife Monitoring First Annual Report: February 2004 - February 2005. Technical report prepared for Eurus Energy America Corporation, San Diego, California, and the Combine Hills Technical Advisory Committee, Umatilla County, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming, and Walla Walla Washington, and Northwest Wildlife Consultants, Inc. (NWC), Pendleton, Oregon. February 21, 2006.

Young, D.P. Jr., J. D. Jeffrey, K. Bay, and W. P. Erickson. 2009c. Puget Sound Energy Hopkins Ridge Wind Project, Phase 1, Columbia County, Washington. Post-Construction Avian and Bat Monitoring, Second Annual Report: January - December, 2008. Prepared for Puget Sound Energy, Dayton, Washington, and the Hopkins Ridge Wind Project Technical Advisory Committee, Columbia County, Washington. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming, and Walla Walla, Washington. May 20, 2009.

Young, D.P. Jr., M. Lout, Z. Courage, S. Nomani, and K. Bay. 2012a. 2011 Post-Construction Monitoring Study, Criterion Wind Project, Garrett County, Maryland: April - November 2011. Prepared for Criterion Power Partners, LLC, Oakland, Maryland. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming, and Waterbury, Vermont. April 20, 2012. Revised November 25, 2013.

Young, D.P. Jr., C. Nations, M. Lout, and K. Bay. 2013. 2012 Post-Construction Monitoring Study, Criterion Wind Project, Garrett County, Maryland. April - November 2012. Prepared for Criterion Power Partners, LLC, Oakland, Maryland. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming, and Waterbury, Vermont. January 15, 2013.

Young, D.P. Jr., S. Nomani, Z. Courage, and K. Bay. 2011a. Nedpower Mount Storm Wind Energy Facility, Post-Construction Avian and Bat Monitoring: April - July 2011. Prepared for NedPower Mount Storm, LLC, Houston, Texas. Prepared by Western EcoSystems Technology (WEST), Inc., Cheyenne, Wyoming. August 29, 2011.

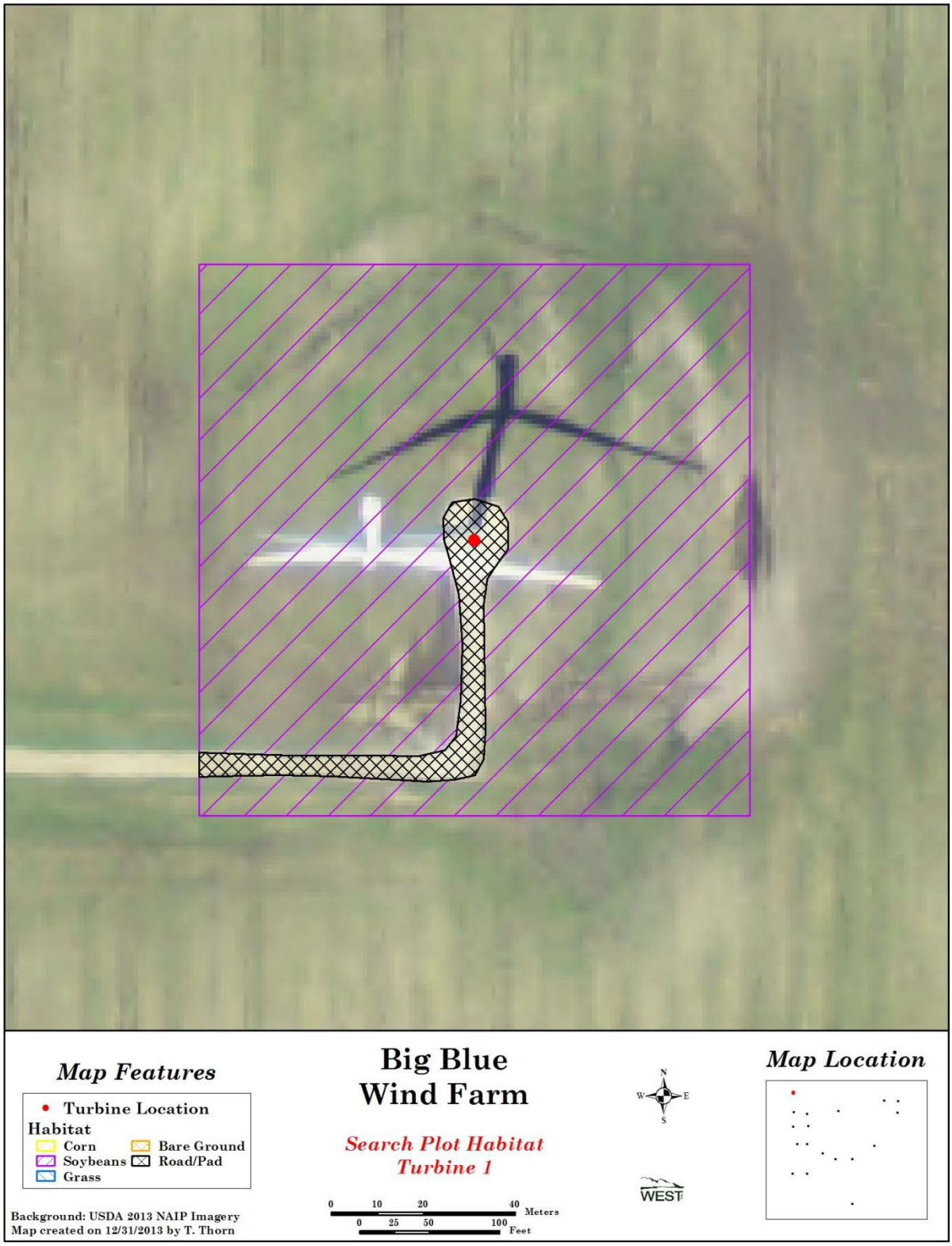
Young, D.P. Jr., S. Nomani, Z. Courage, and K. Bay. 2012b. Nedpower Mount Storm Wind Energy Facility, Post-Construction Avian and Bat Monitoring: July - October 2011. Prepared for NedPower Mount Storm, LLC, Houston, Texas. Prepared by Western EcoSystems Technology (WEST), Inc., Cheyenne, Wyoming. February 27, 2012.

Young, D.P. Jr., S. Nomani, W. Tidhar, and K. Bay. 2011b. Nedpower Mount Storm Wind Energy Facility, Post-Construction Avian and Bat Monitoring: July - October 2010. Prepared for NedPower Mount Storm, LLC, Houston, Texas. Prepared by Western EcoSystems Technology (WEST), Inc., Cheyenne, Wyoming. February 10, 2011.

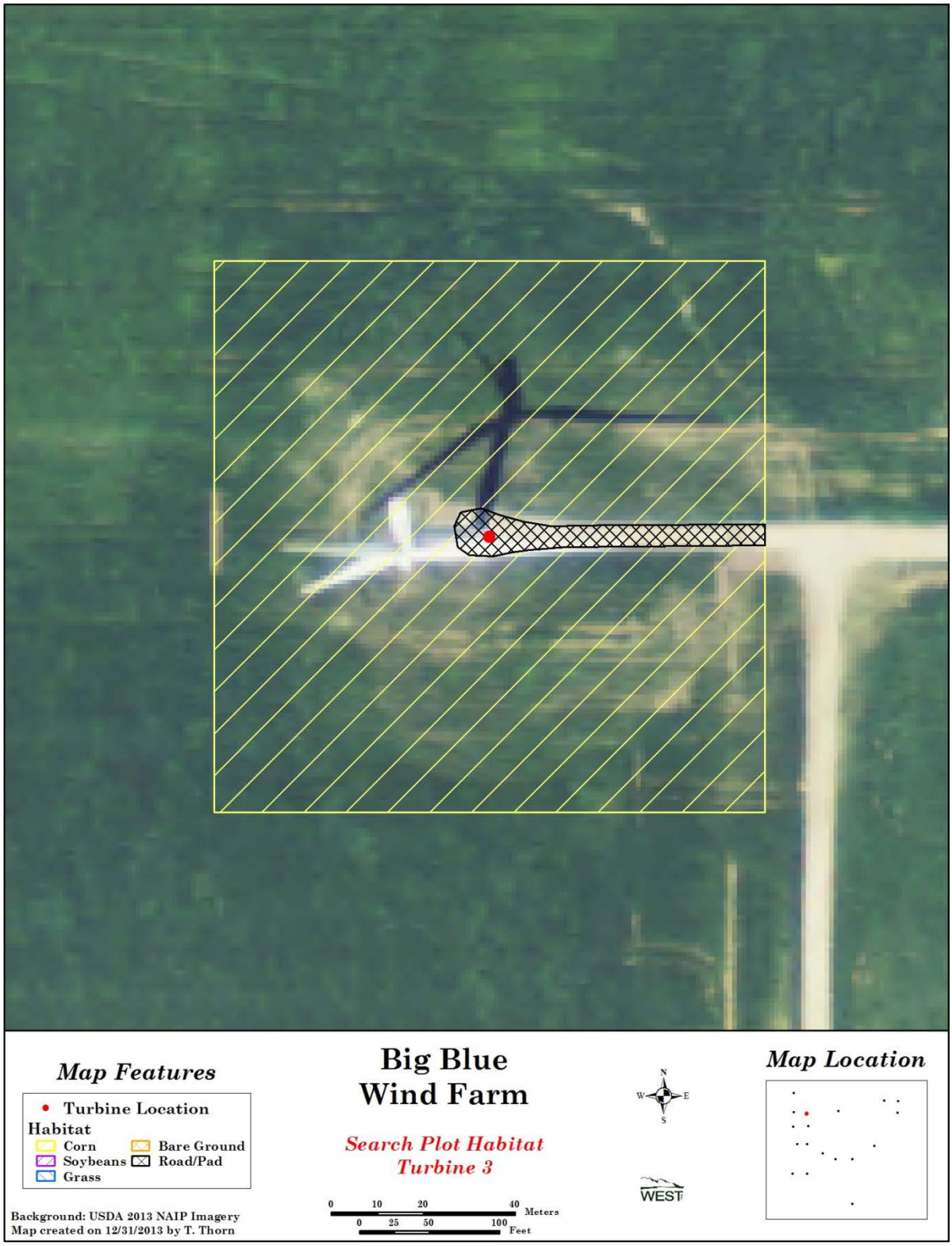
Appendix A. Habitat and Visibility Classes Breakdown for Turbines at Big Blue, Grand Meadow, and Oak Glen Wind Energy Facilities for 2013

Appendix A-1. Habitat breakdown and visibility class for turbines at the Big Blue Wind Farm with full plots from July 9 – October 31, 2013.

Turbine	Habitat	Date	Class	Date	Class	Date	Class	Date	Class	Acres
BB T1	soybeans	7/3/2013	2	8/3/2013	4	9/3/2013	4	10/8/2013	1	3.38
BB T1	rd/pad	7/3/2013	1	8/3/2013	1	9/3/2013	1	10/8/2013	1	0.18
BB T3	corn	7/3/2013	4	8/3/2013	4	9/3/2013	4	10/22/2013	1	3.47
BB T3	rd/pad	7/3/2013	1	8/3/2013	1	9/3/2013	1	10/22/2013	1	0.09
BB T4	soybeans	7/3/2013	2	8/3/2013	4	9/3/2013	4	10/9/2013	1	1.70
BB T4	rd/pad	7/3/2013	1	8/3/2013	1	9/3/2013	1	10/13/2013	1	0.20
BB T4	corn	7/3/2013	4	8/3/2013	4	9/3/2013	4	10/13/2013	1	1.41
BB T4	bare	7/3/2013	1	8/3/2013	1	9/3/2013	1	10/13/2013	1	0.25
BB T7	soybeans	7/3/2013	2	8/3/2013	4	9/3/2013	4	10/9/2013	1	1.92
BB T7	rd/pad	7/3/2013	1	8/3/2013	1	9/3/2013	1	10/9/2013	1	0.17
BB T7	grass	7/3/2013	4	8/3/2013	4	9/3/2013	4	10/9/2013	4	1.14
BB T7	corn	7/3/2013	1	8/3/2013	4	9/3/2013	4	9/23/2013	1	0.33
BB T8	soybeans	7/3/2013	2	8/3/2013	4	9/3/2013	4	10/2/2013	1	3.40
BB T8	rd/pad	7/3/2013	1	8/3/2013	1	9/3/2013	1	10/2/2013	1	0.15
BB T11	corn	7/3/2013	4	8/3/2013	4	9/3/2013	4	10/22/2013	1	1.65
BB T11	rd/pad	7/3/2013	1	8/3/2013	1	9/3/2013	1	10/22/2013	1	0.19
BB T11	soybeans	7/3/2013	1	8/3/2013	4	9/3/2013	4	10/1/2013	1	0.11
BB T11	soybeans	7/3/2013	1	8/3/2013	4	9/3/2013	4	10/1/2013	1	1.61
BB T13	rd/pad	---	---	---	1	9/3/2013	1	10/8/2013	1	0.23
BB T13	soybeans	---	---	---	4	9/3/2013	4	10/8/2013	1	3.33
BB T14	soybeans	7/3/2013	1	8/3/2013	4	9/3/2013	4	10/1/2013	1	3.36
BB T14	rd/pad	7/3/2013	1	8/3/2013	1	9/3/2013	1	10/1/2013	1	0.20
BB T16	corn	7/3/2013	4	8/3/2013	4	9/3/2013	4	10/29/2013	1	1.76
BB T16	corn	7/3/2013	4	8/3/2013	4	9/3/2013	4	10/29/2013	4	0.66
BB T16	corn	7/3/2013	4	8/3/2013	4	9/3/2013	4	10/29/2013	4	0.90
BB T16	rd/pad	7/3/2013	1	8/3/2013	1	9/3/2013	1	10/29/2013	1	0.19
BB T16	bare	7/3/2013	1	8/3/2013	1	9/3/2013	1	10/29/2013	1	0.02
BB T16	bare	7/3/2013	1	8/3/2013	1	9/3/2013	1	10/29/2013	1	0.03
BB T18	corn	7/3/2013	4	8/3/2013	4	9/3/2013	4	10/19/2013	1	3.27
BB T18	rd/pad	7/3/2013	1	8/3/2013	1	9/3/2013	1	10/19/2013	1	0.20
BB T18	bare	7/3/2013	1	8/3/2013	1	9/3/2013	1	10/19/2013	1	0.08

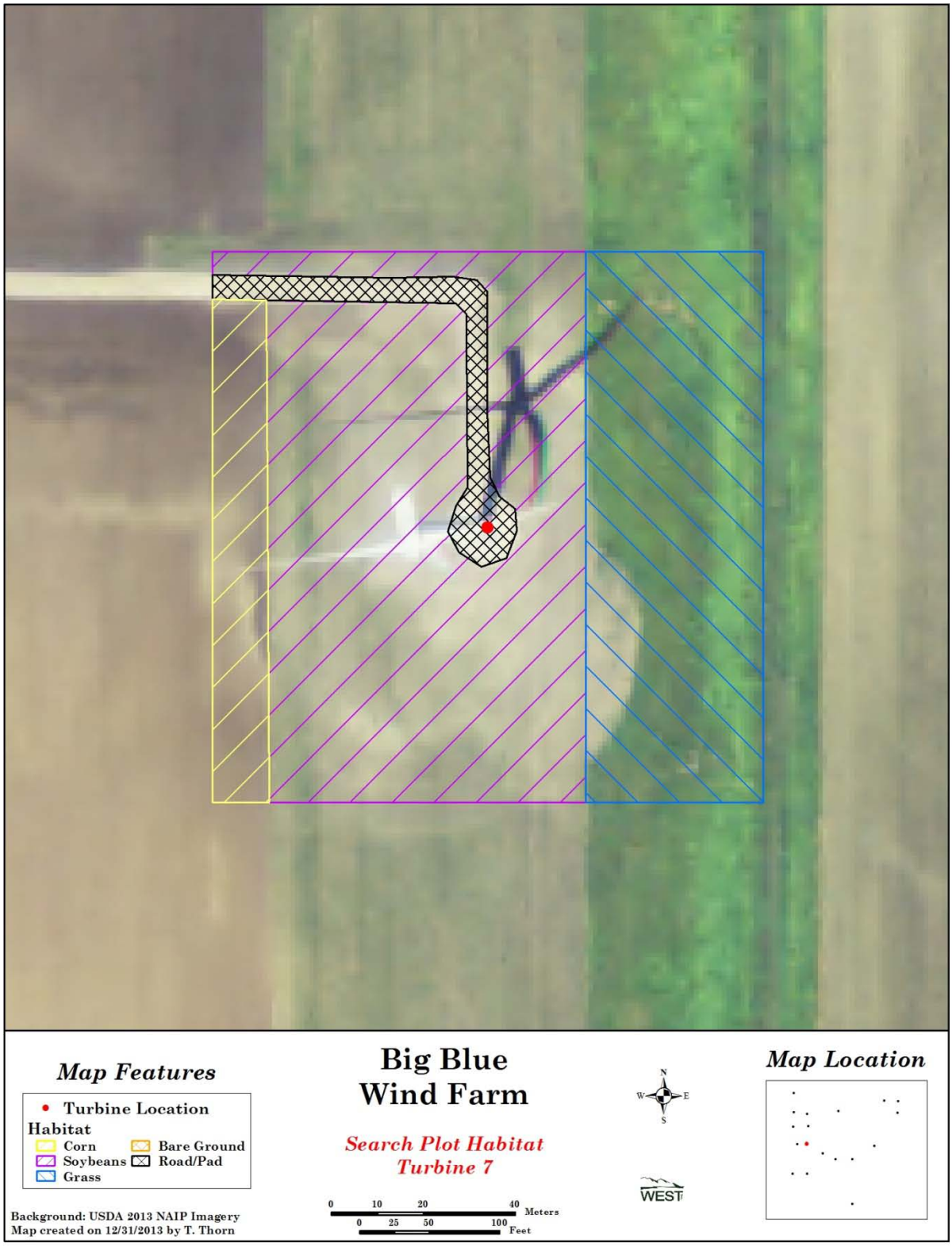


Appendix A-1. Habitat breakdown for turbine 1 at the Big Blue Wind Farm from July 9 – October 31, 2013.

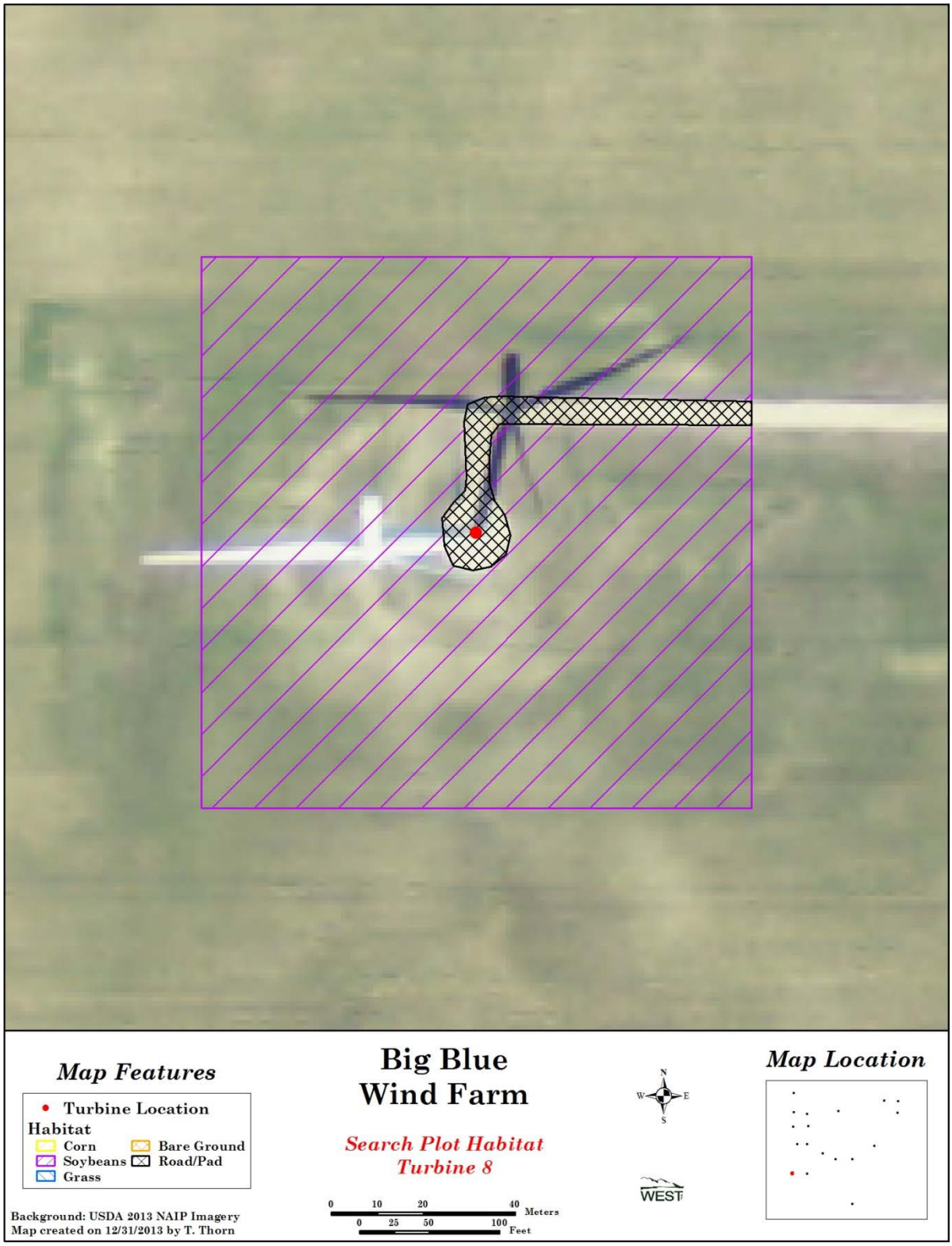


Appendix A-1. Habitat breakdown for turbine 3 at the Big Blue Wind Farm from July 9 – October 31, 2013.

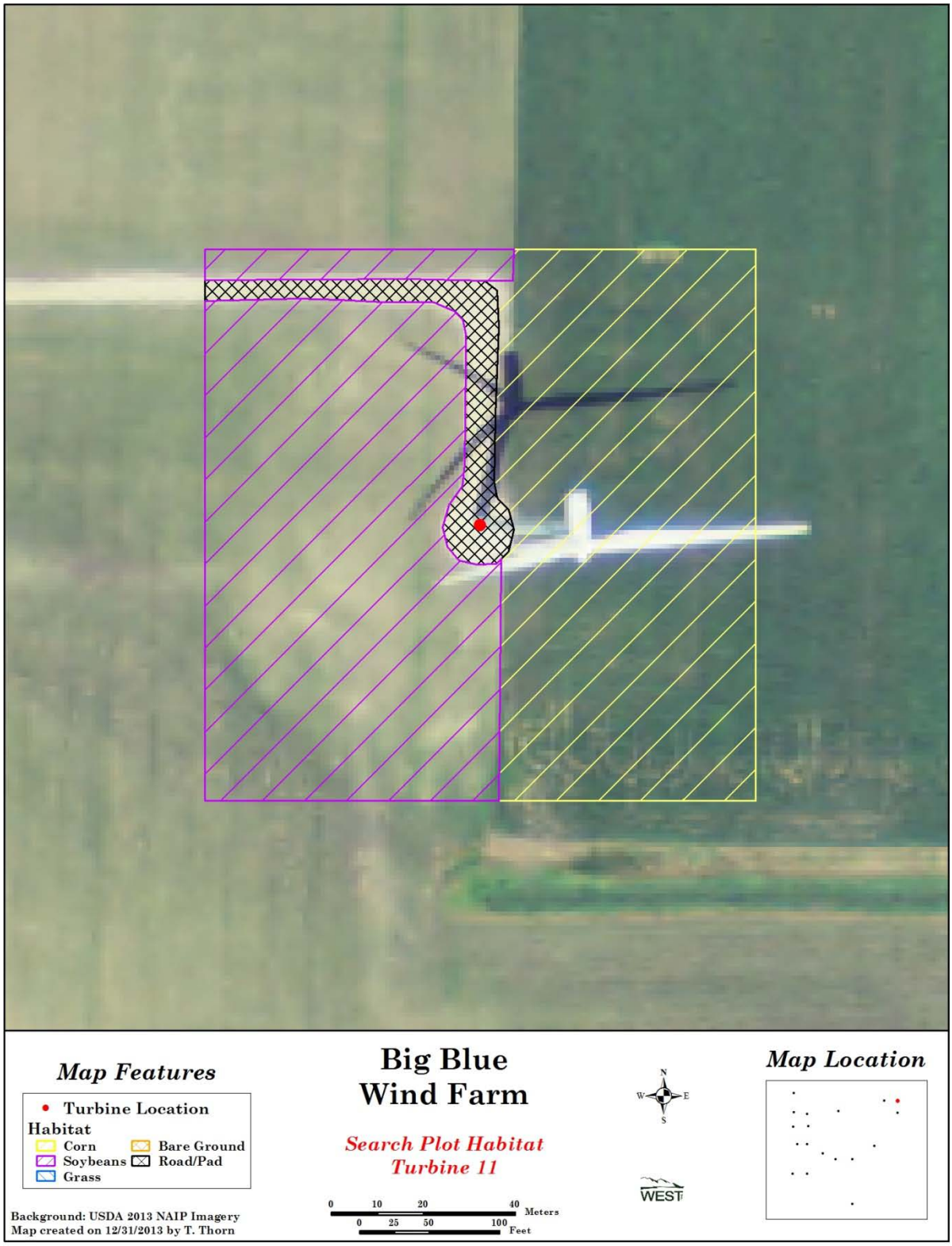
Appendix A-1. Habitat breakdown for turbine 4 at the Big Blue Wind Farm from July 9 – October 31, 2013.



Appendix A-1. Habitat breakdown for turbine 7 at the Big Blue Wind Farm from July 9 – October 31, 2013.

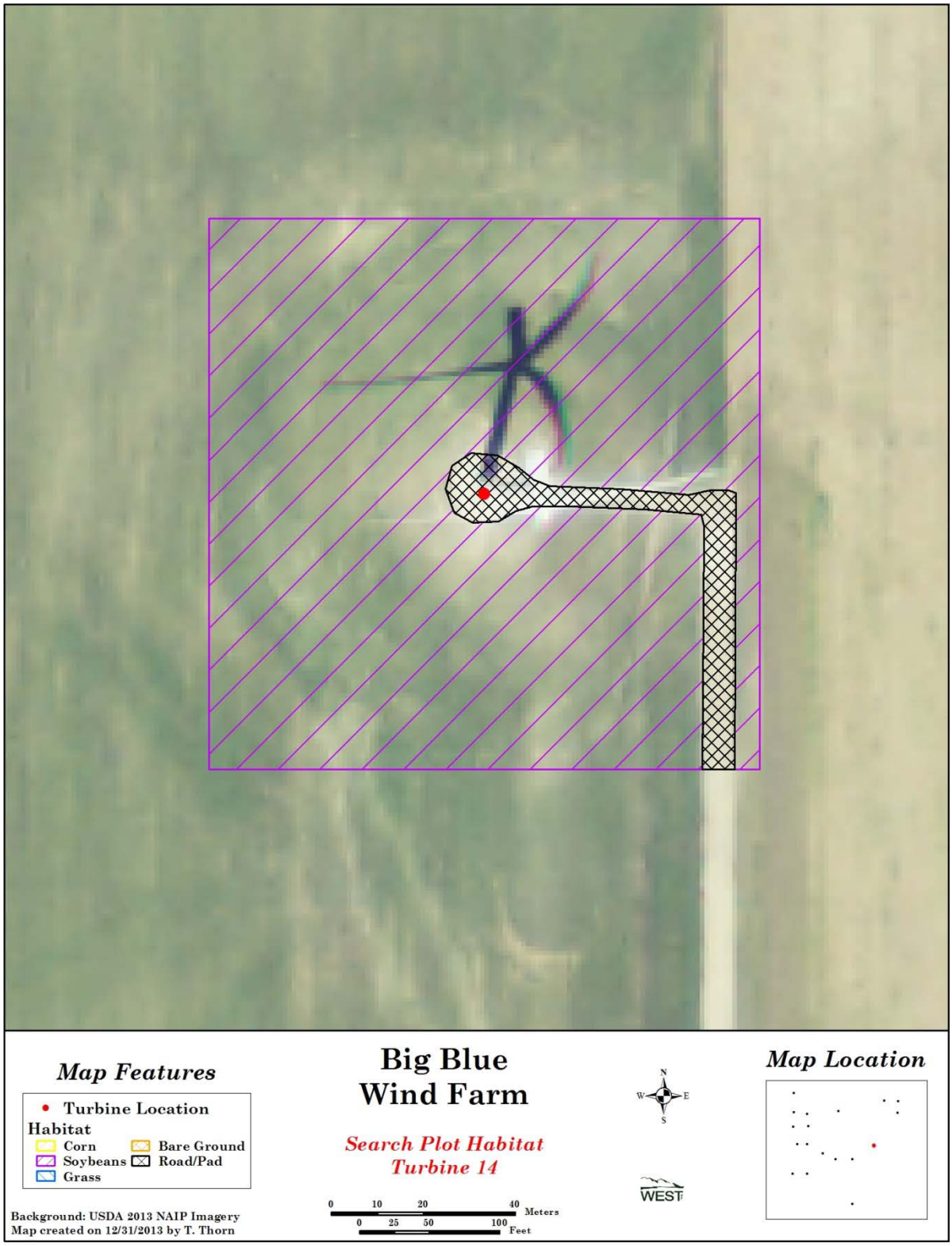


Appendix A-1. Habitat breakdown for turbine 8 at the Big Blue Wind Farm from July 9 – October 31, 2013.

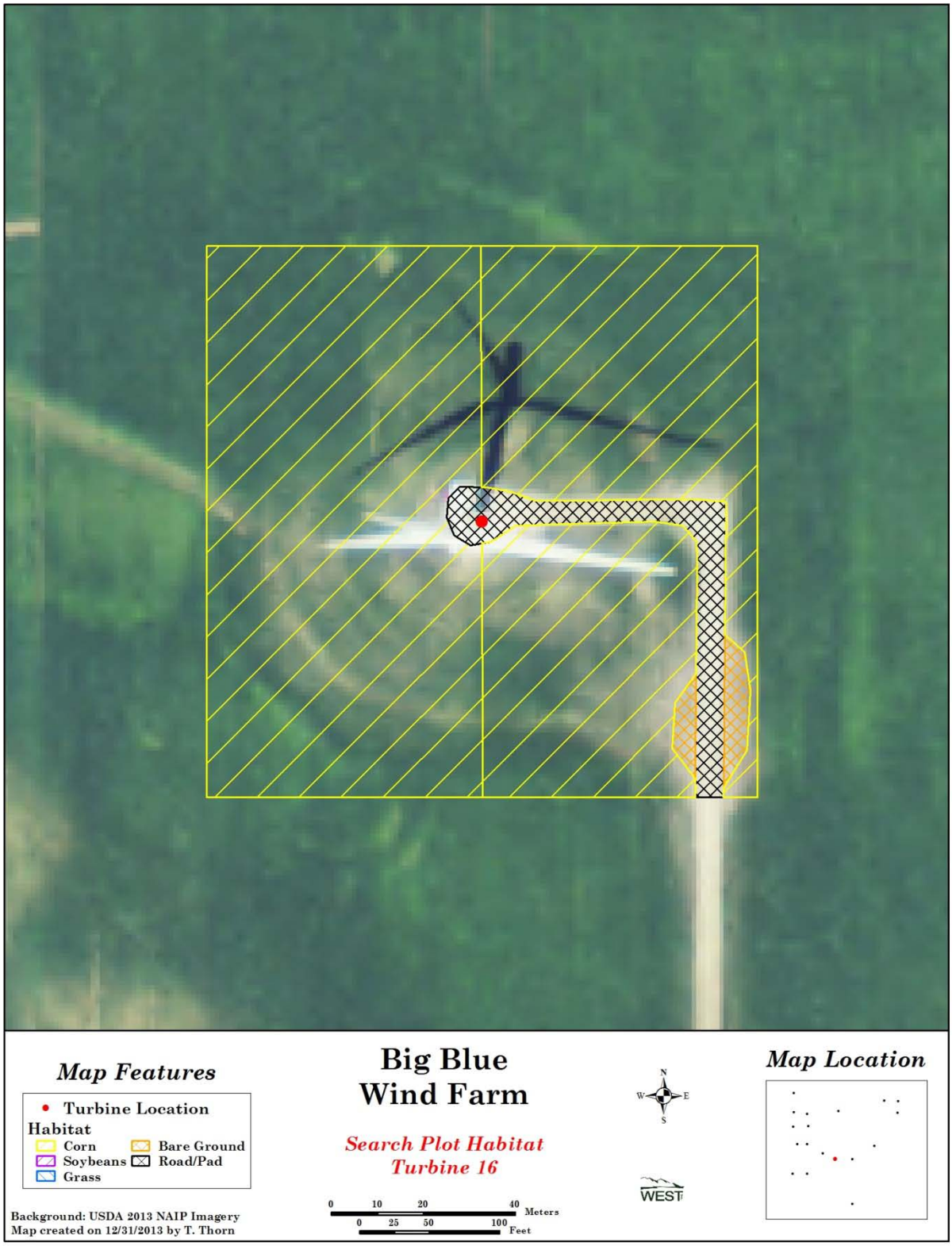


Appendix A-1. Habitat breakdown for turbine 11 at the Big Blue Wind Farm from July 9 – October 31, 2013.

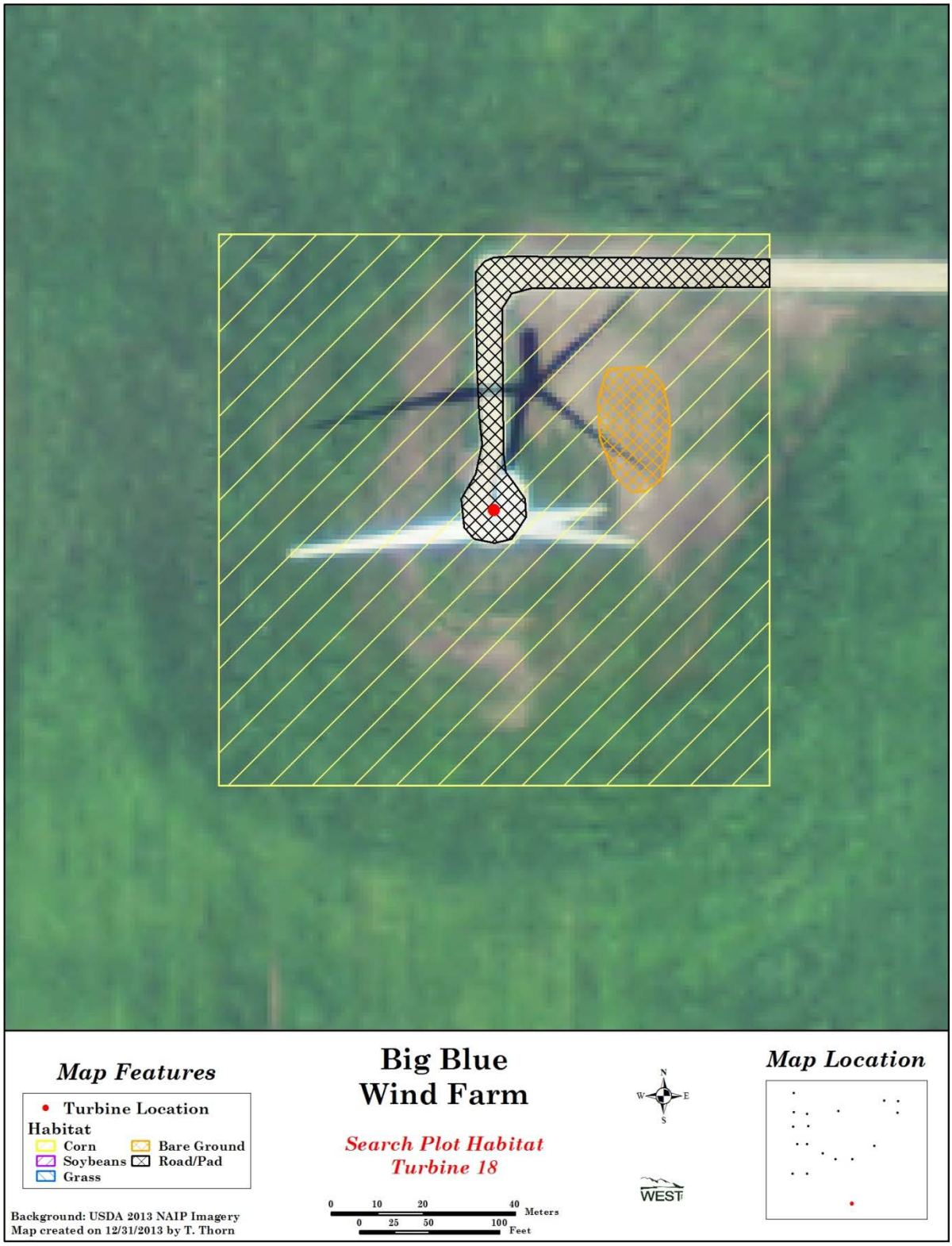
Appendix A-1. Habitat breakdown for turbine 13 at the Big Blue Wind Farm from July 9 – October 31, 2013.



Appendix A-1. Habitat breakdown for turbine 14 at the Big Blue Wind Farm from July 9 – October 31, 2013.



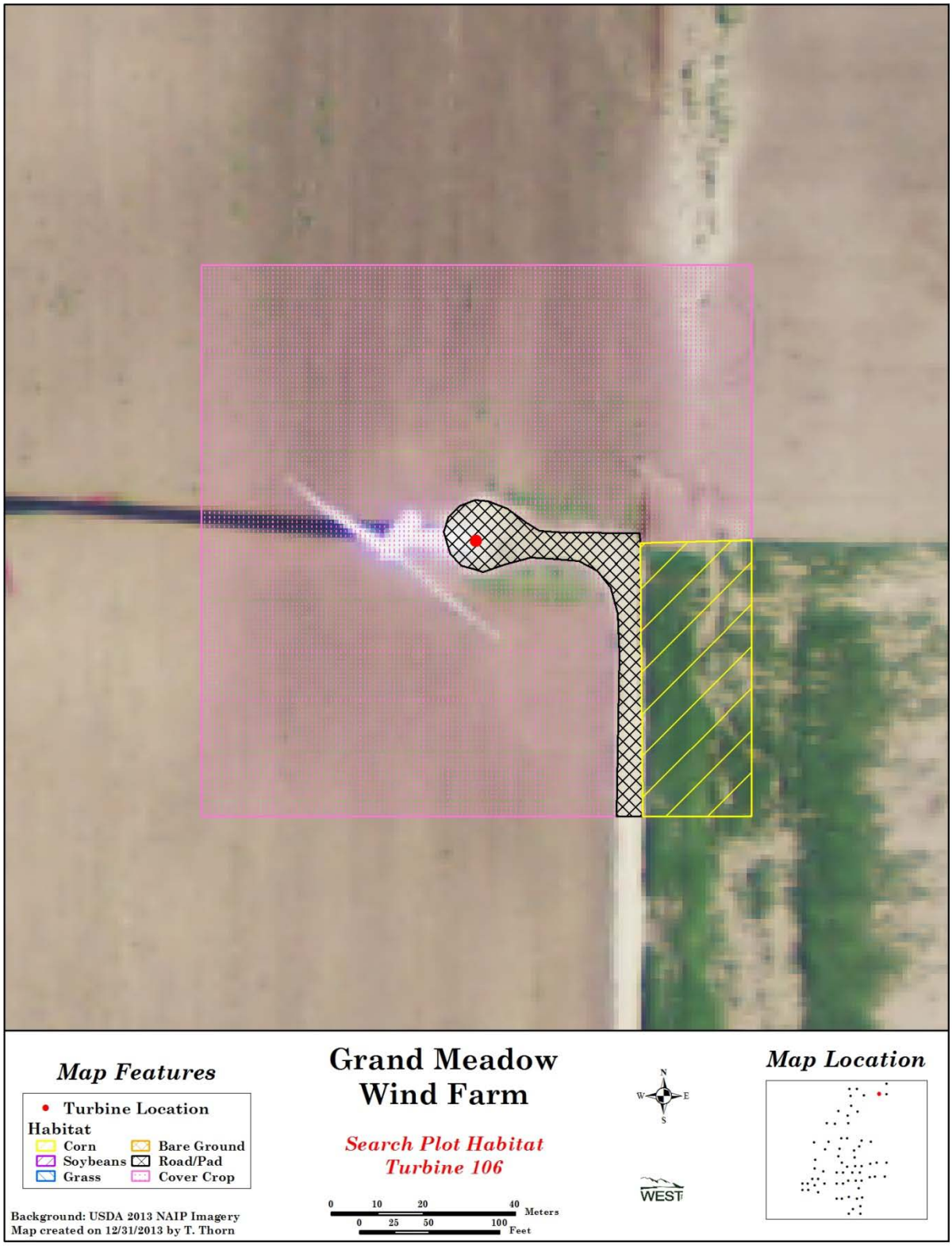
Appendix A-1. Habitat breakdown for turbine 16 at the Big Blue Wind Farm from July 9 – October 31, 2013.



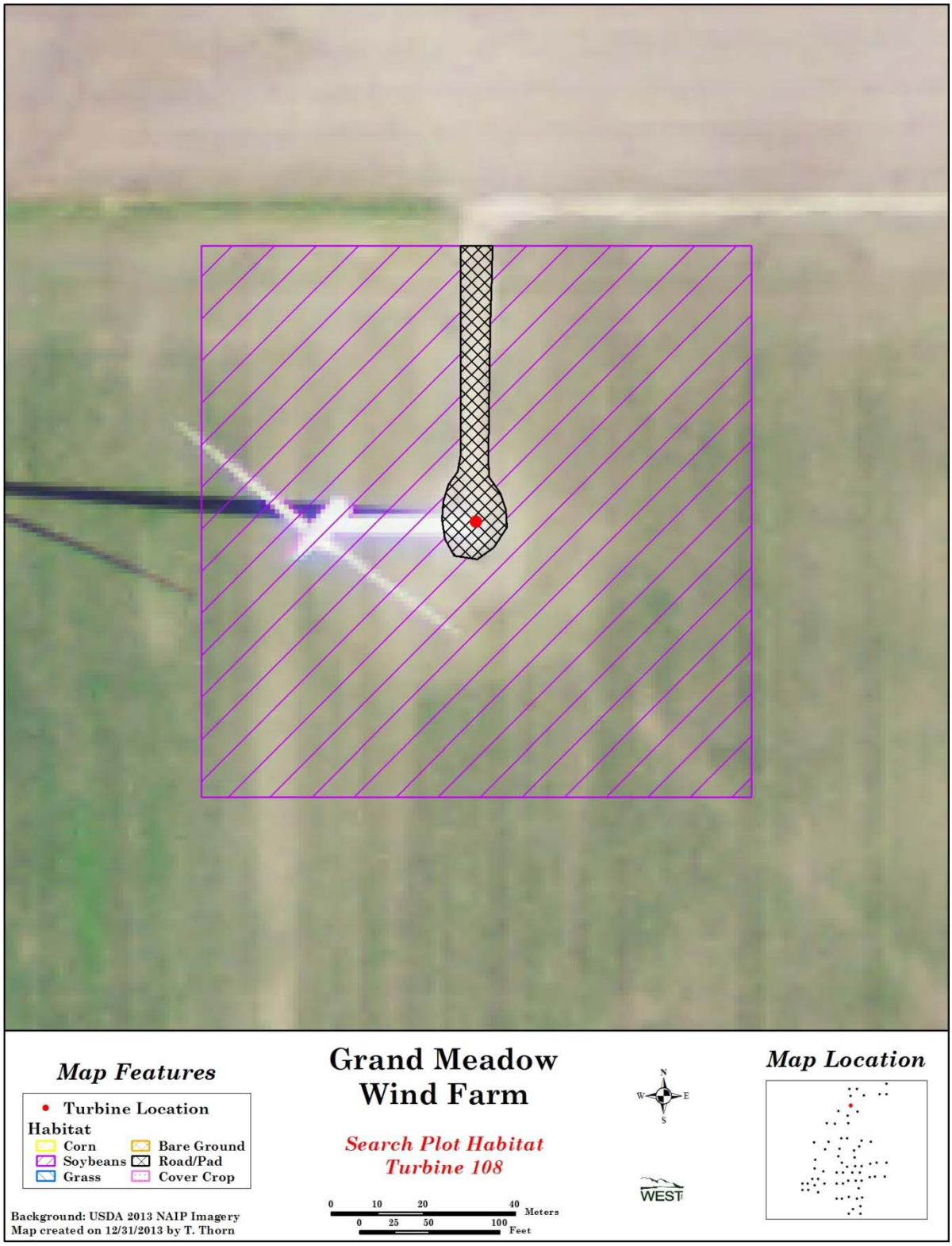
Appendix A-1. Habitat breakdown for turbine 18 at the Big Blue Wind Farm from July 9 – October 31, 2013.

Appendix A-2. Habitat breakdown and visibility class for turbines at the Grand Meadow Wind Farm with full plots from July 12 – October 31, 2013.

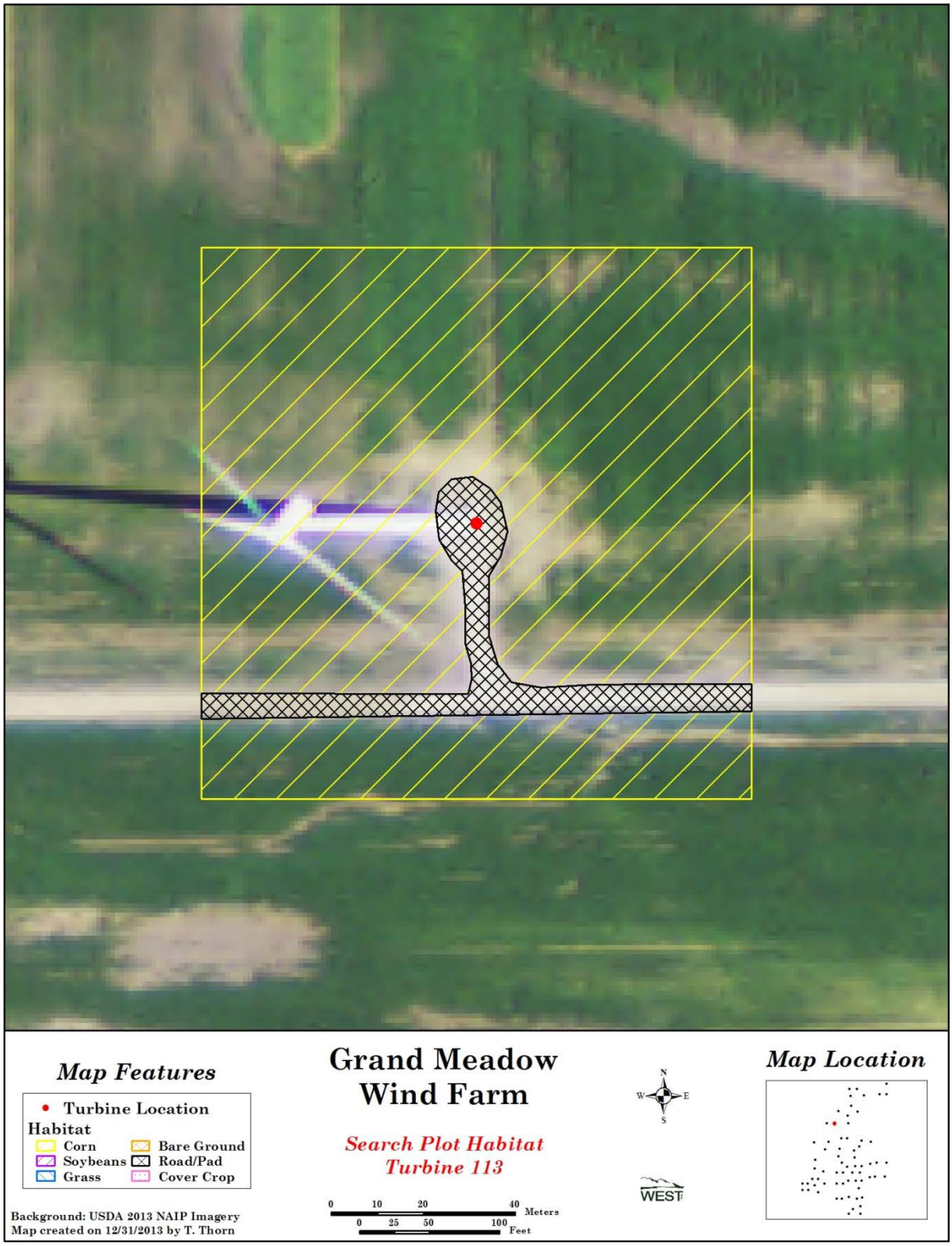
Turbine	Habitat	Date	Class	Date	Class	Date	Class	Acres
GM T106	corn	7/3/2013	4	8/1/2013	4	9/20/2013	4	0.36
GM T106	cover crop	7/3/2013	1	8/1/2013	1	9/20/2013	4	3.03
GM T106	road/pad	7/3/2013	1	8/1/2013	1	9/20/2013	1	0.17
GM T108	road/pad	7/3/2013	1	8/1/2013	1	9/20/2013	1	0.13
GM T108	soybeans	7/3/2013	2	8/1/2013	2	9/20/2013	4	3.43
GM T113	corn	7/3/2013	4	8/1/2013	4	9/20/2013	4	2.75
GM T113	corn	7/3/2013	4	8/1/2013	4	9/20/2013	4	0.54
GM T113	road/pad	7/3/2013	1	8/1/2013	1	9/20/2013	1	0.26
GM T116	cover crop	7/3/2013	1	8/1/2013	2	9/20/2013	4	3.43
GM T116	road/pad	7/3/2013	1	8/1/2013	1	9/20/2013	1	0.13
GM T117	road/pad	7/3/2013	1	8/1/2013	1	9/20/2013	1	0.14
GM T117	soybeans	7/3/2013	2	8/1/2013	3	9/20/2013	4	3.42
GM T121	corn	7/3/2013	4	8/1/2013	4	9/20/2013	4	1.66
GM T121	cover crop	7/3/2013	1	8/1/2013	1	9/20/2013	4	1.78
GM T121	road/pad	7/3/2013	1	8/1/2013	1	9/20/2013	1	0.12
GM T125	corn	7/3/2013	4	8/1/2013	4	9/20/2013	4	1.08
GM T125	grass	7/3/2013	3	8/1/2013	3	9/20/2013	2	0.13
GM T125	road/pad	7/3/2013	1	8/1/2013	1	9/20/2013	1	0.15
GM T125	soybeans	7/3/2013	2	8/1/2013	2	9/20/2013	4	2.20
GM T139	corn	7/3/2013	4	8/1/2013	4	9/20/2013	4	0.17
GM T139	grass	7/3/2013	4	8/1/2013	4	9/20/2013	4	0.13
GM T139	road/pad	7/3/2013	1	8/1/2013	1	9/20/2013	1	0.11
GM T139	soybeans	7/3/2013	3	8/1/2013	4	9/20/2013	4	3.15
GM T144	corn	7/3/2013	4	8/1/2013	4	9/20/2013	4	3.42
GM T144	road/pad	7/3/2013	1	8/1/2013	1	9/20/2013	1	0.13
GM T152	corn	7/3/2013	4	8/1/2013	4	9/20/2013	4	0.42
GM T152	road/pad	7/3/2013	1	8/1/2013	1	9/20/2013	1	0.26
GM T152	soybeans	7/3/2013	2	8/1/2013	3	9/20/2013	4	2.88
GM T154	corn	7/3/2013	4	8/1/2013	4	9/20/2013	4	3.44
GM T154	road/pad	7/3/2013	1	8/1/2013	1	9/20/2013	1	0.12
GM T160	road/pad	7/3/2013	1	8/1/2013	1	9/20/2013	1	0.19
GM T160	soybeans	7/3/2013	2	8/1/2013	2	9/20/2013	4	2.23
GM T160	soybeans	7/3/2013	2	8/1/2013	2	9/20/2013	4	1.14
GM T162	bare	7/3/2013	1	8/1/2013	2	9/20/2013	1	1.20
GM T162	cover crop	7/3/2013	1	8/1/2013	2	9/20/2013	4	2.16



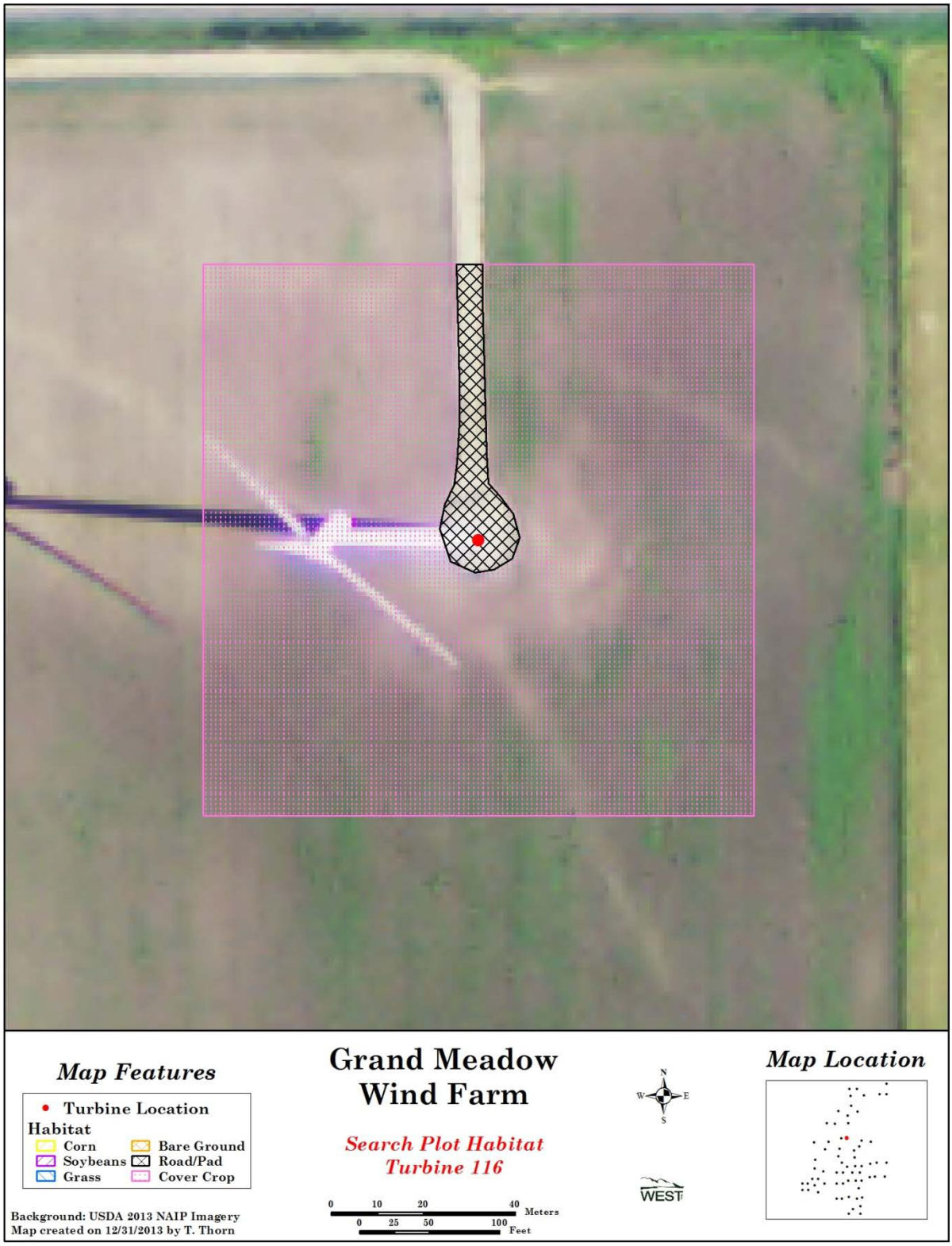
Appendix A-2. Habitat breakdown for turbine 106 at the Grand Meadow Wind Farm from July 12 – October 31, 2013.



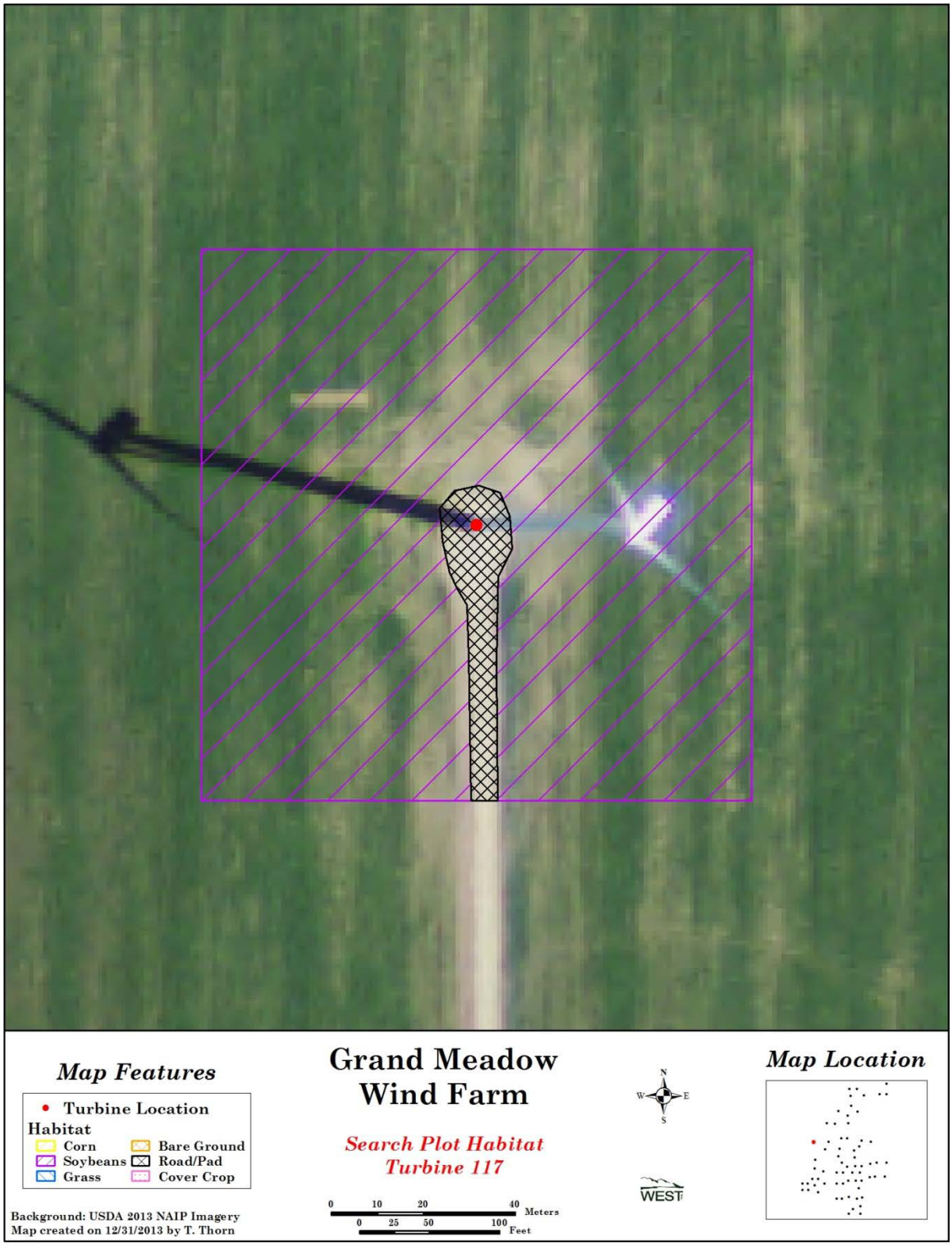
Appendix A-2. Habitat breakdown for turbine 108 at the Grand Meadow Wind Farm from July 12 – October 31, 2013.



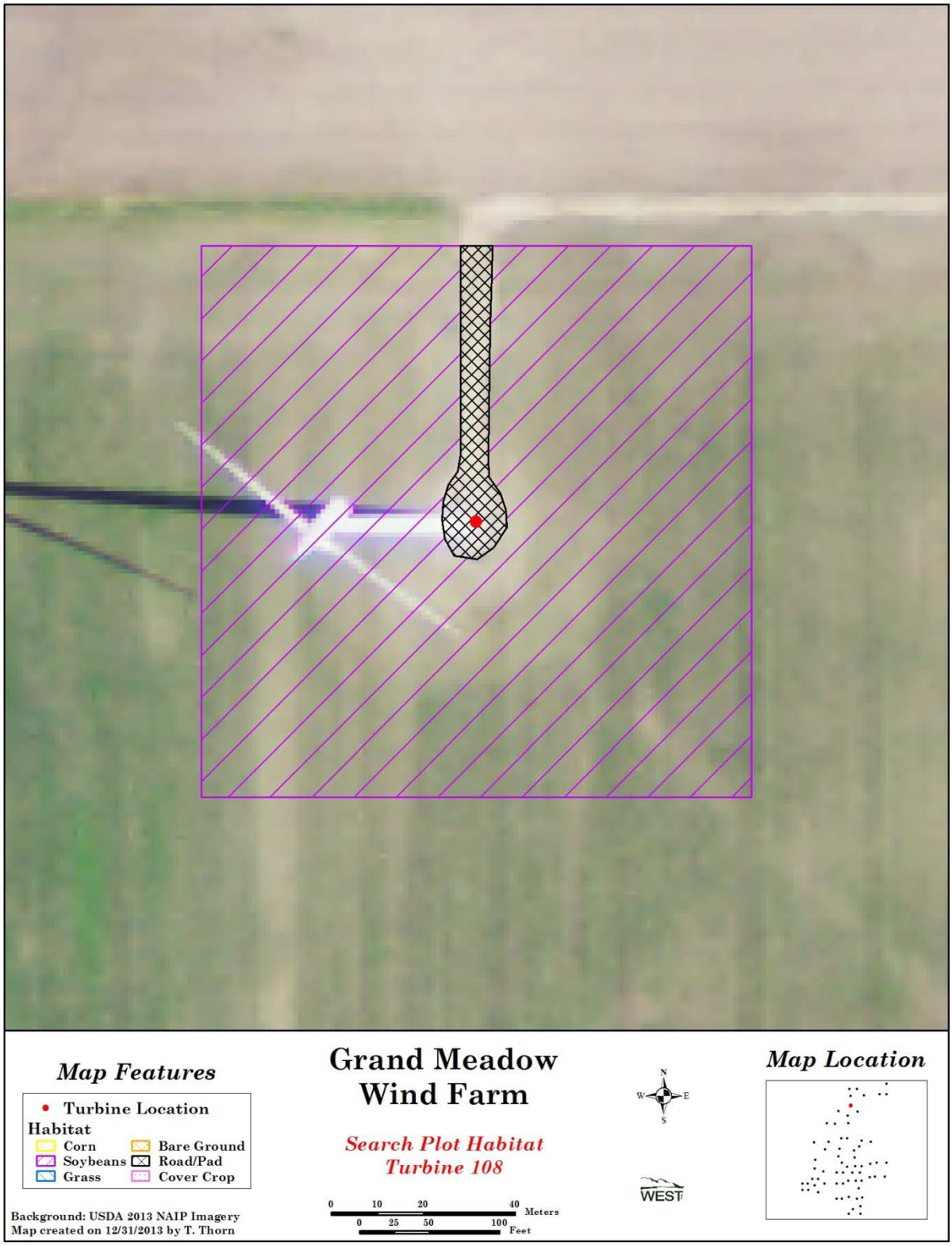
Appendix A-2. Habitat breakdown for turbine 113 at the Grand Meadow Wind Farm from July 12 – October 31, 2013.



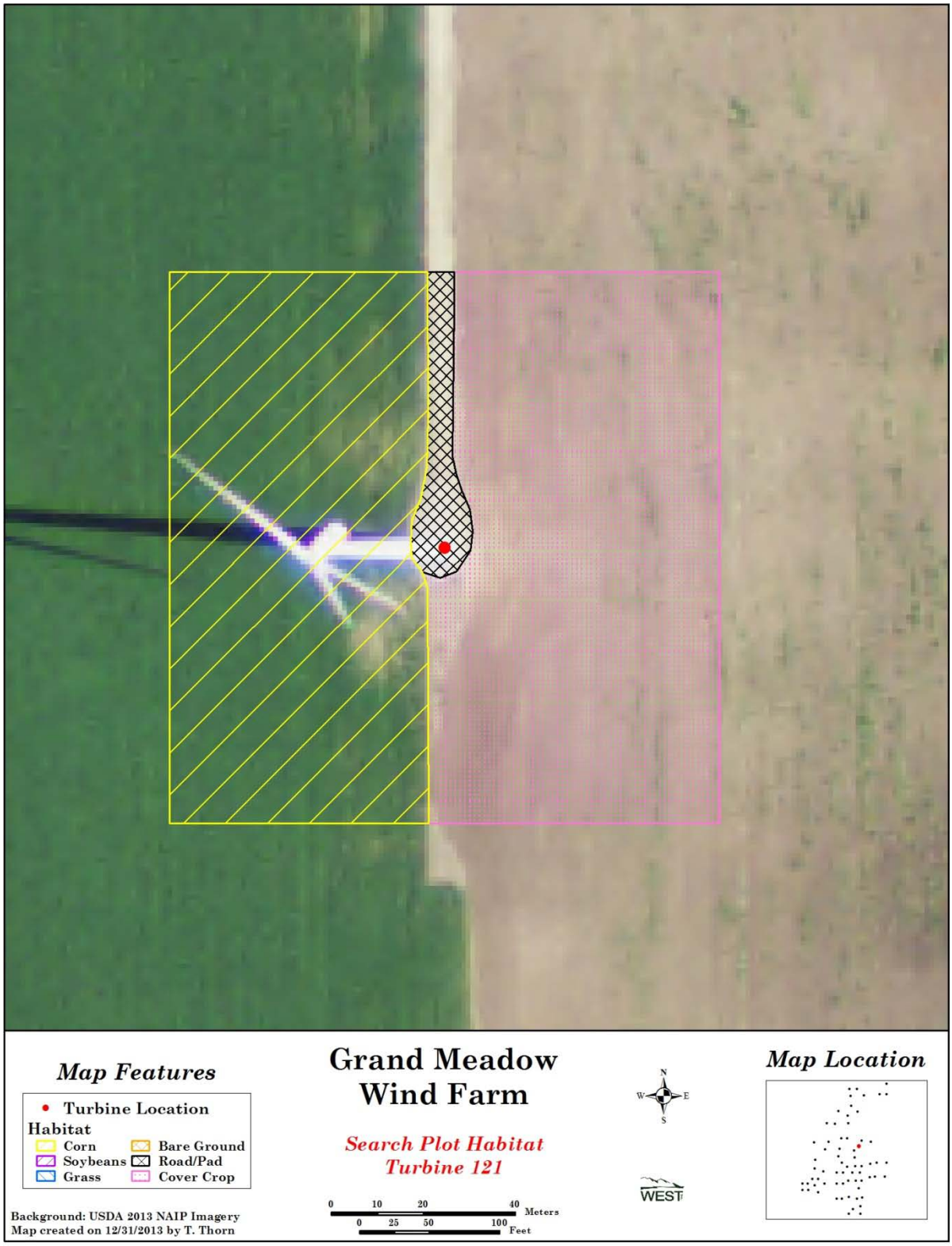
Appendix A-2. Habitat breakdown for turbine 116 at the Grand Meadow Wind Farm from July 12 – October 31, 2013.



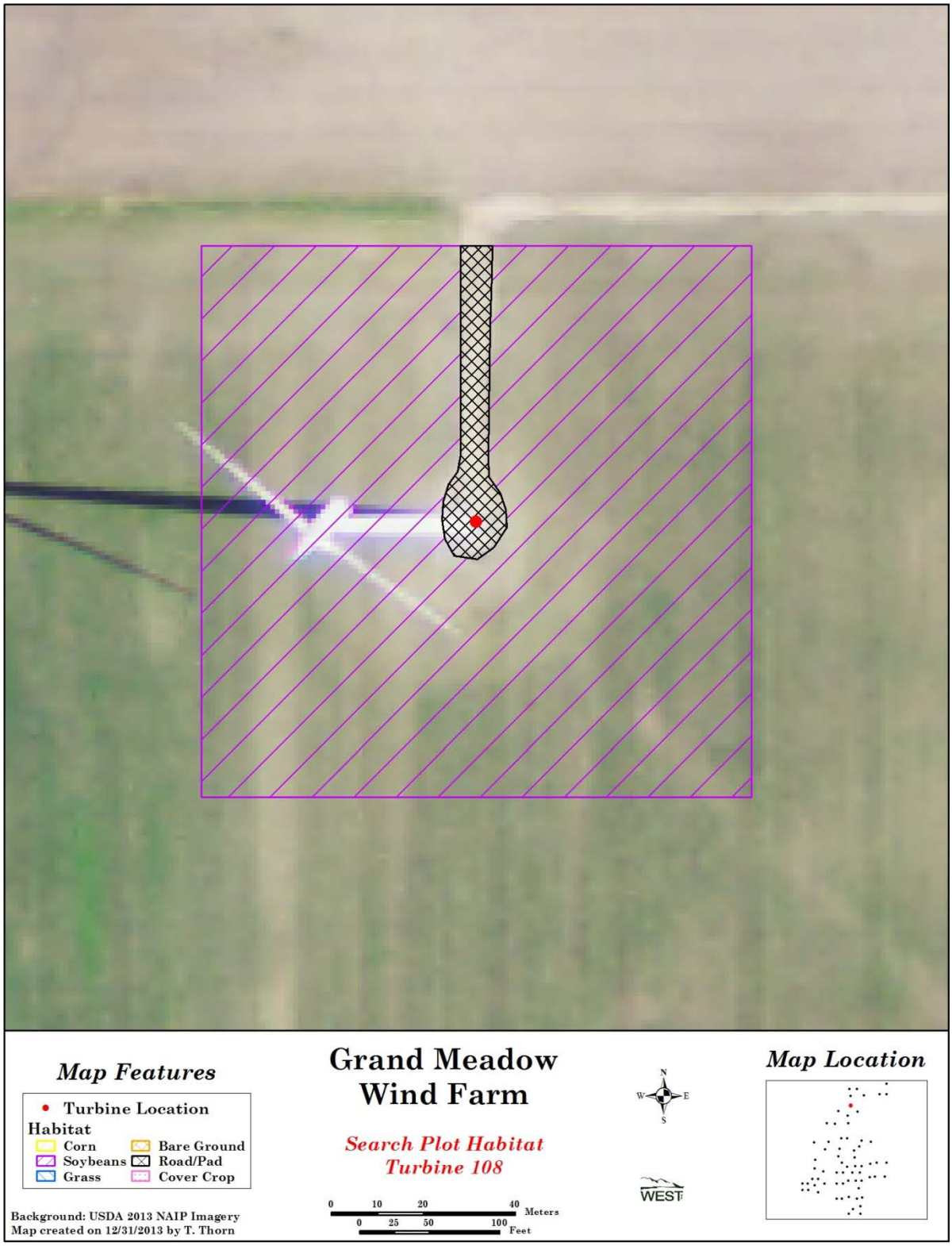
Appendix A-2. Habitat breakdown for turbine 117 at the Grand Meadow Wind Farm from July 12 – October 31, 2013.



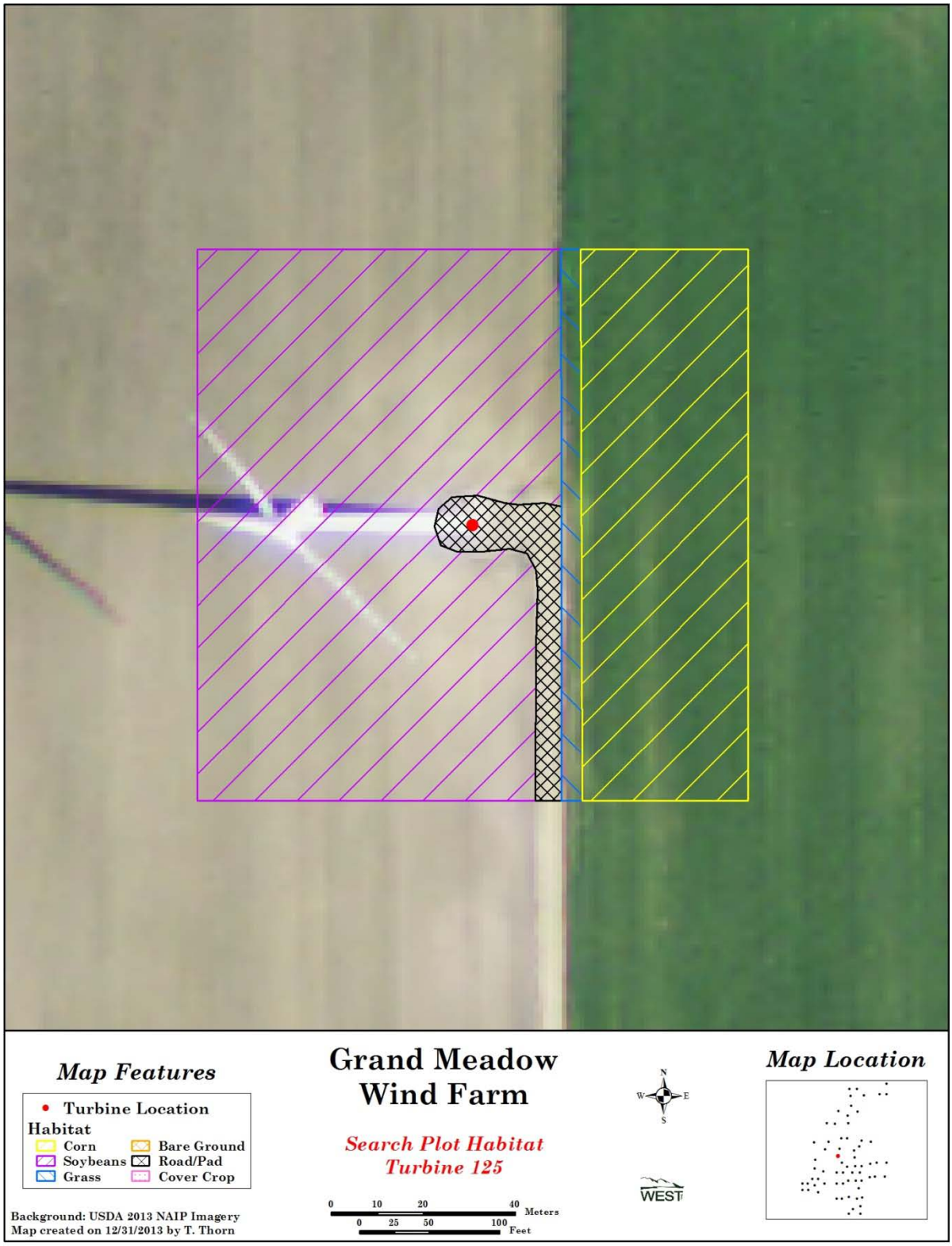
Appendix A-2. Habitat breakdown for turbine 108 at the Grand Meadow Wind Farm from July 12 – October 31, 2013.



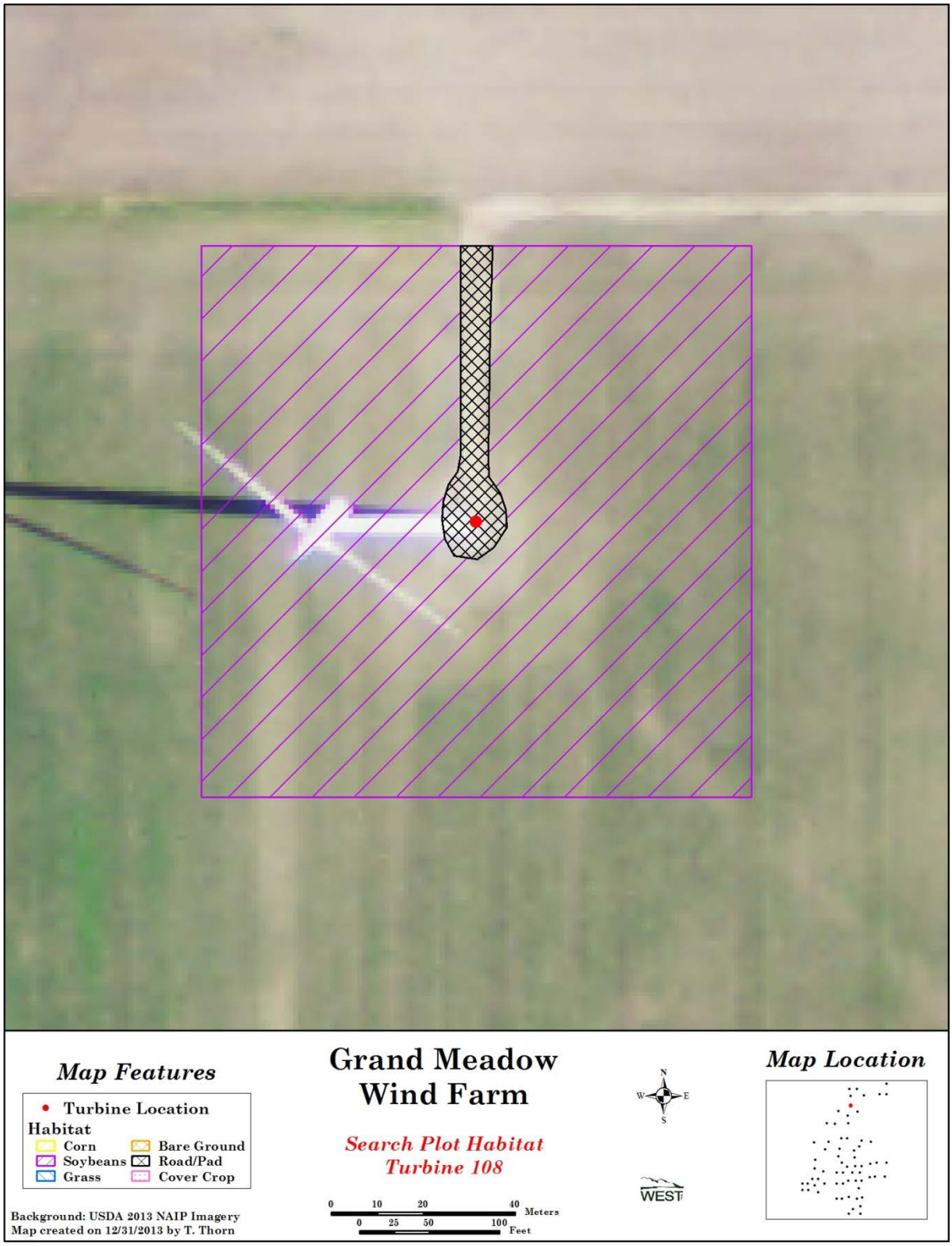
Appendix A-2. Habitat breakdown for turbine 121 at the Grand Meadow Wind Farm from July 12 – October 31, 2013.



Appendix A-2. Habitat breakdown for turbine 108 at the Grand Meadow Wind Farm from July 12 – October 31, 2013.

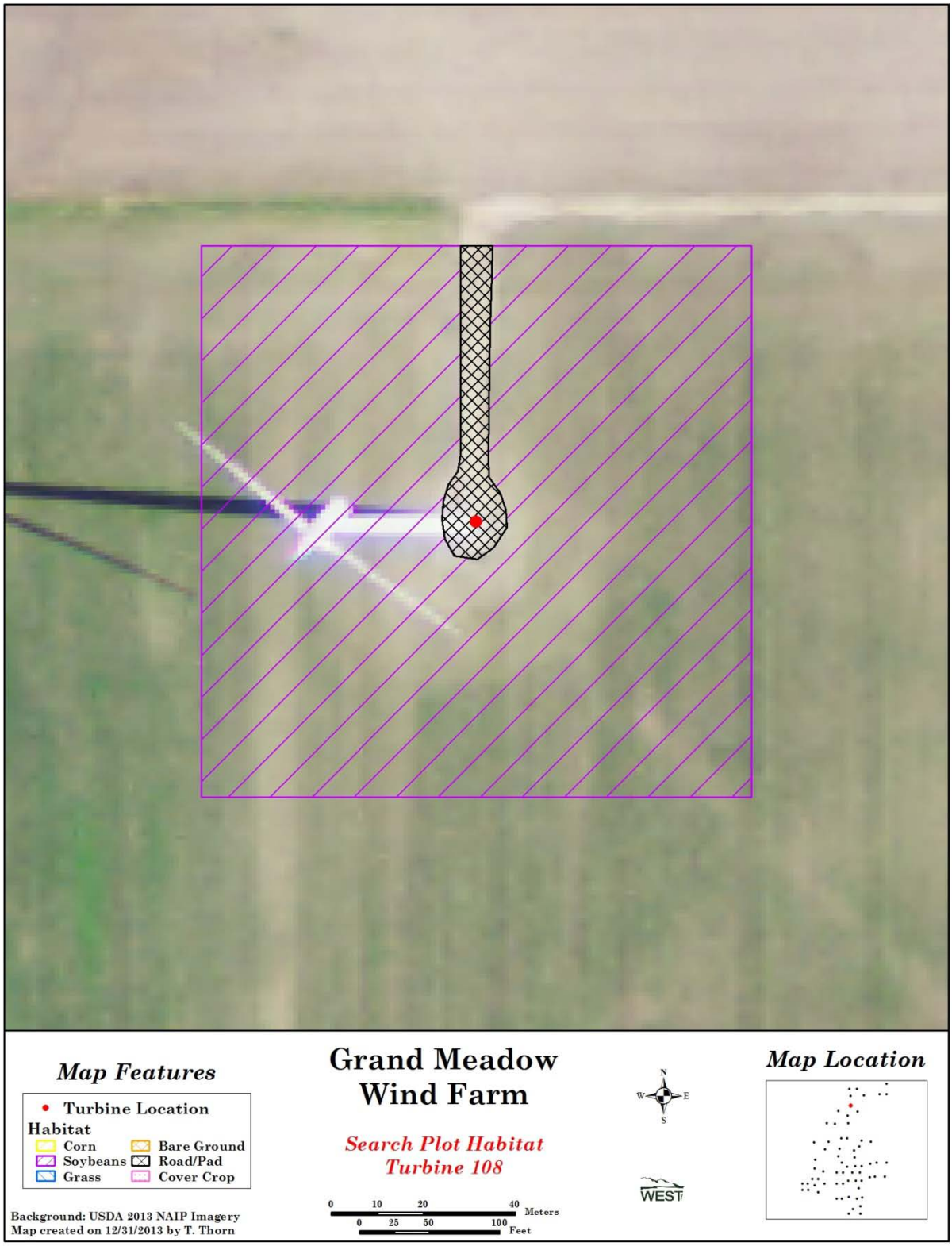


Appendix A-2. Habitat breakdown for turbine 125 at the Grand Meadow Wind Farm from July 12 – October 31, 2013.



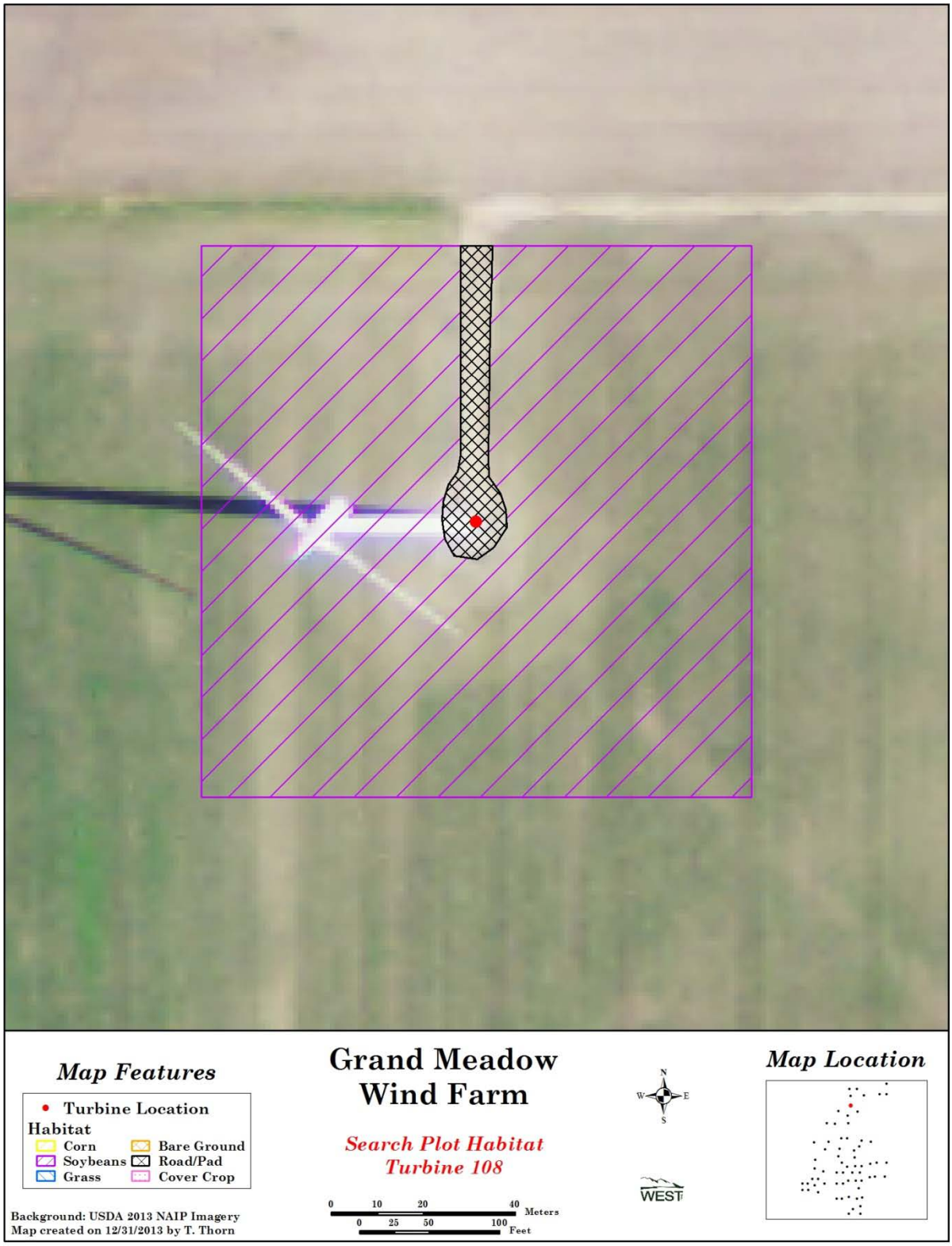
Appendix A-2. Habitat breakdown for turbine 108 at the Grand Meadow Wind Farm from July 12 – October 31, 2013.

Appendix A-2. Habitat breakdown for turbine 139 at the Grand Meadow Wind Farm from July 12 – October 31, 2013.

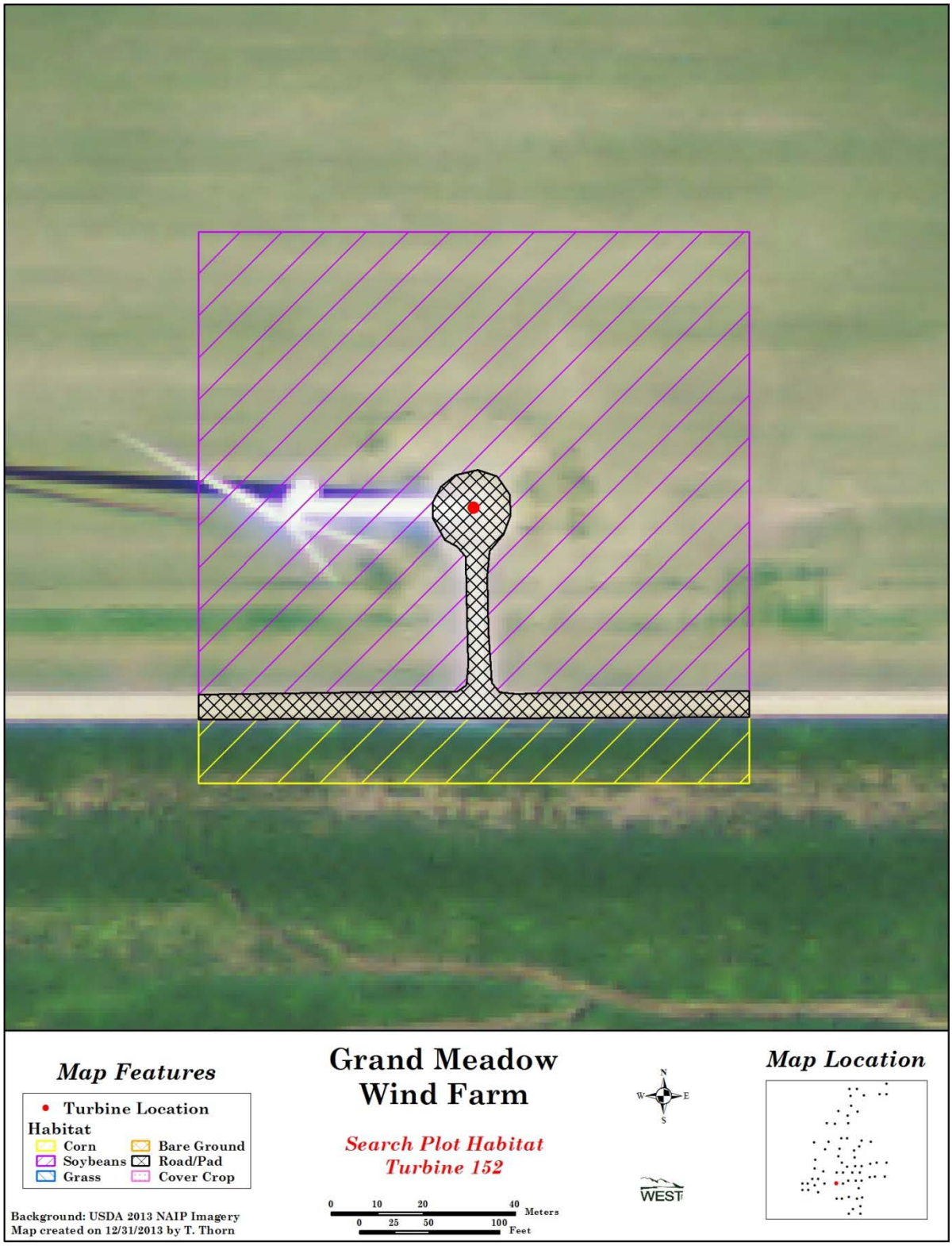


Appendix A-2. Habitat breakdown for turbine 108 at the Grand Meadow Wind Farm from July 12 – October 31, 2013.

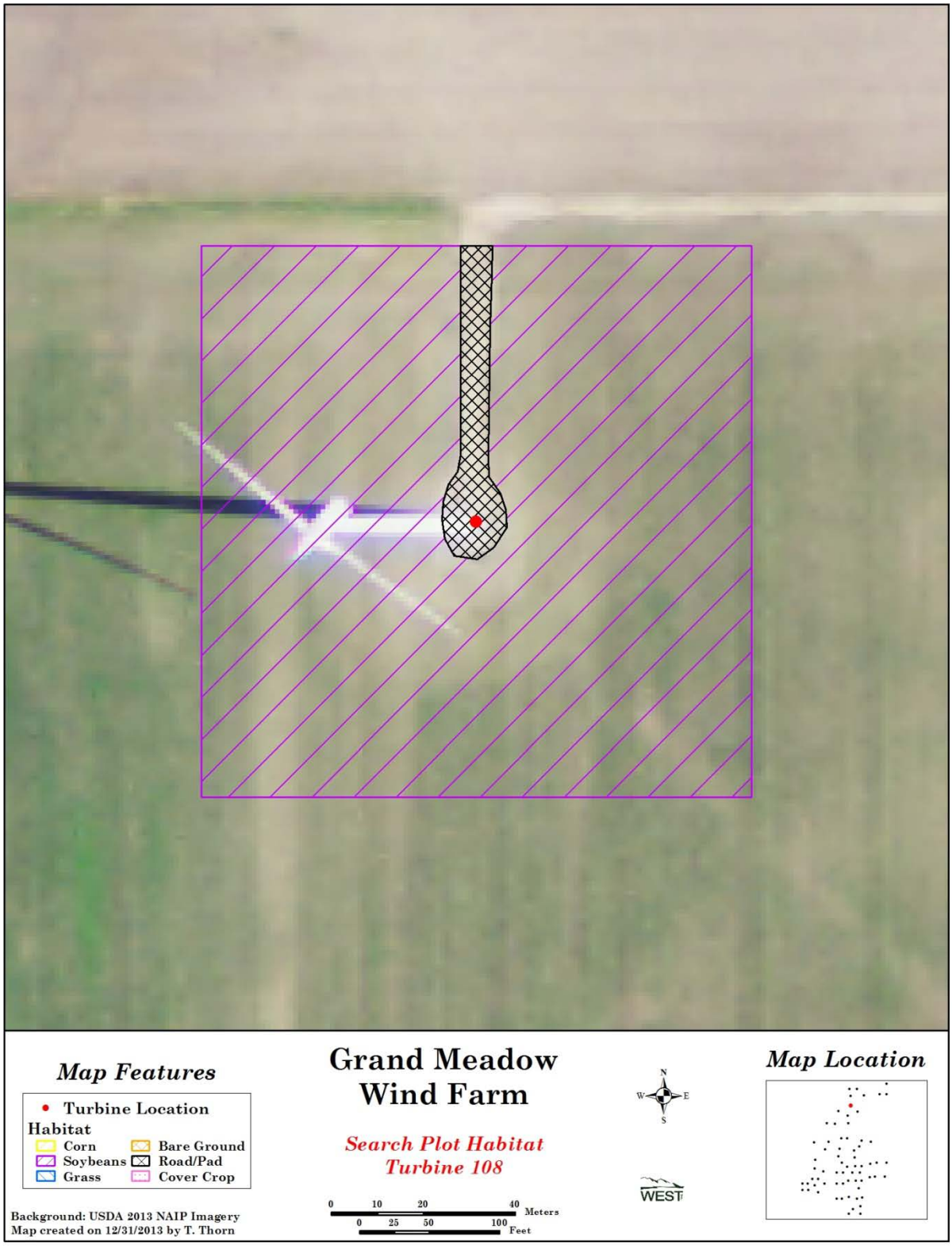
Appendix A-2. Habitat breakdown for turbine 144 at the Grand Meadow Wind Farm from July 12 – October 31, 2013.



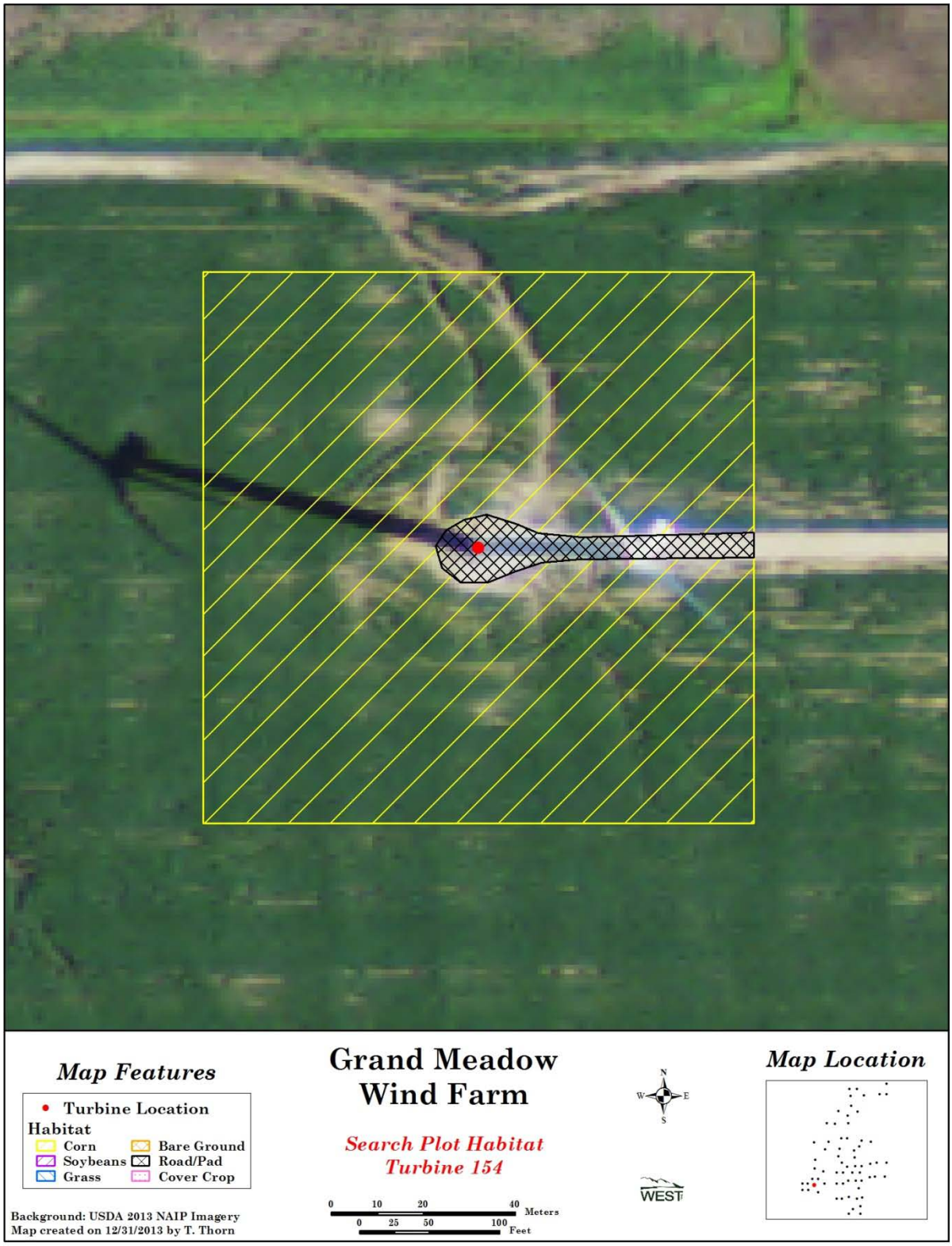
Appendix A-2. Habitat breakdown for turbine 108 at the Grand Meadow Wind Farm from July 12 – October 31, 2013.



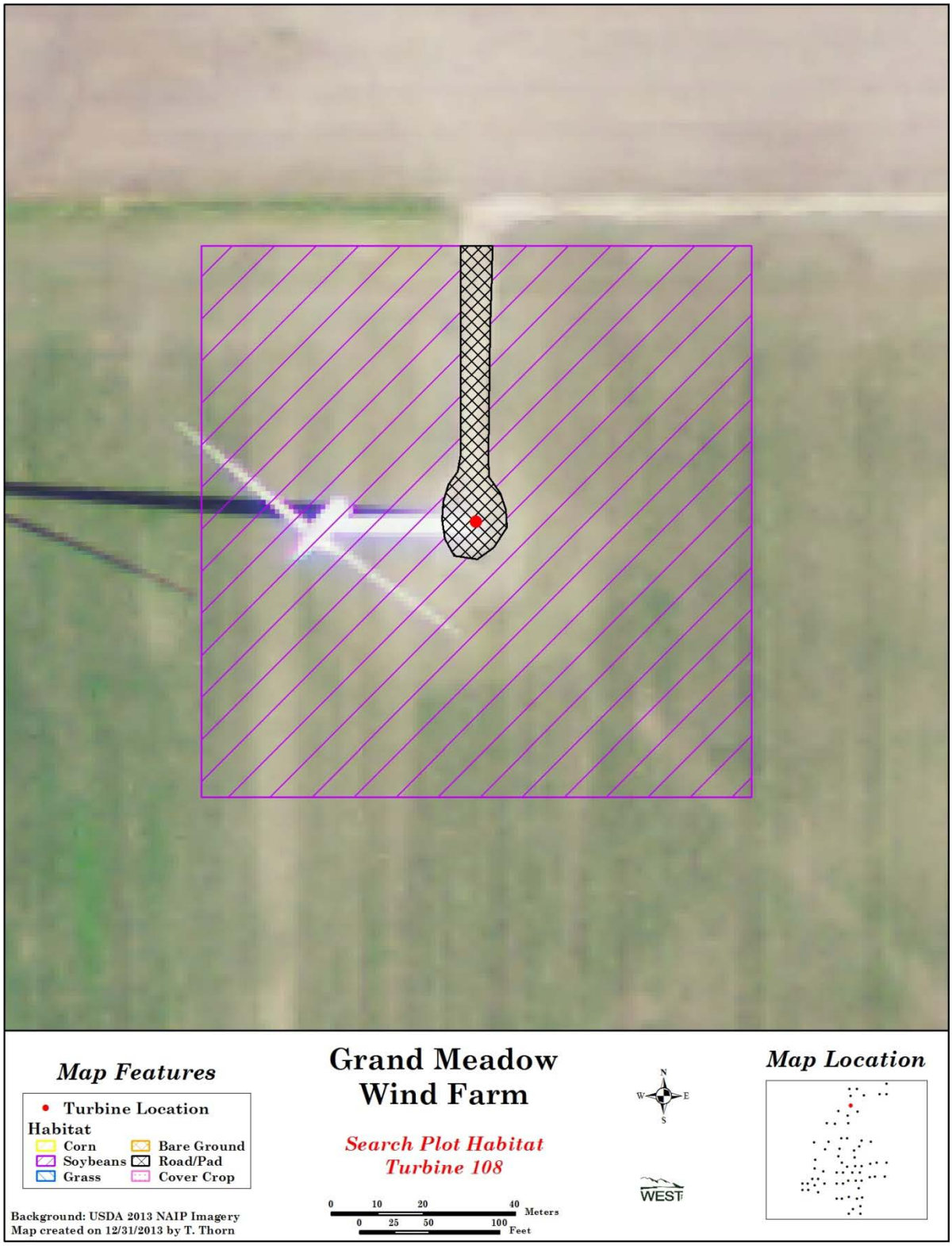
Appendix A-2. Habitat breakdown for turbine 152 at the Grand Meadow Wind Farm from July 12 – October 31, 2013.



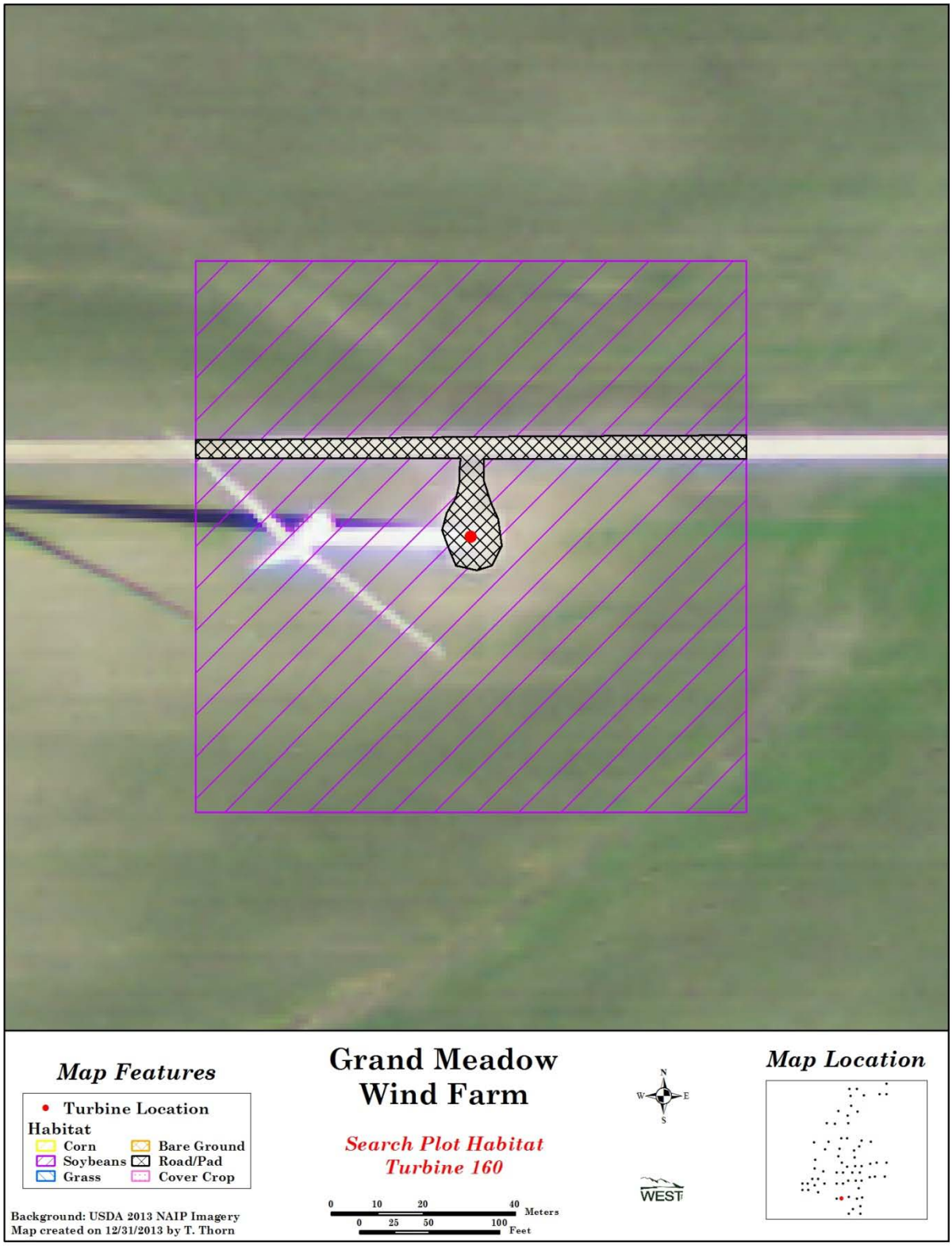
Appendix A-2. Habitat breakdown for turbine 108 at the Grand Meadow Wind Farm from July 12 – October 31, 2013.



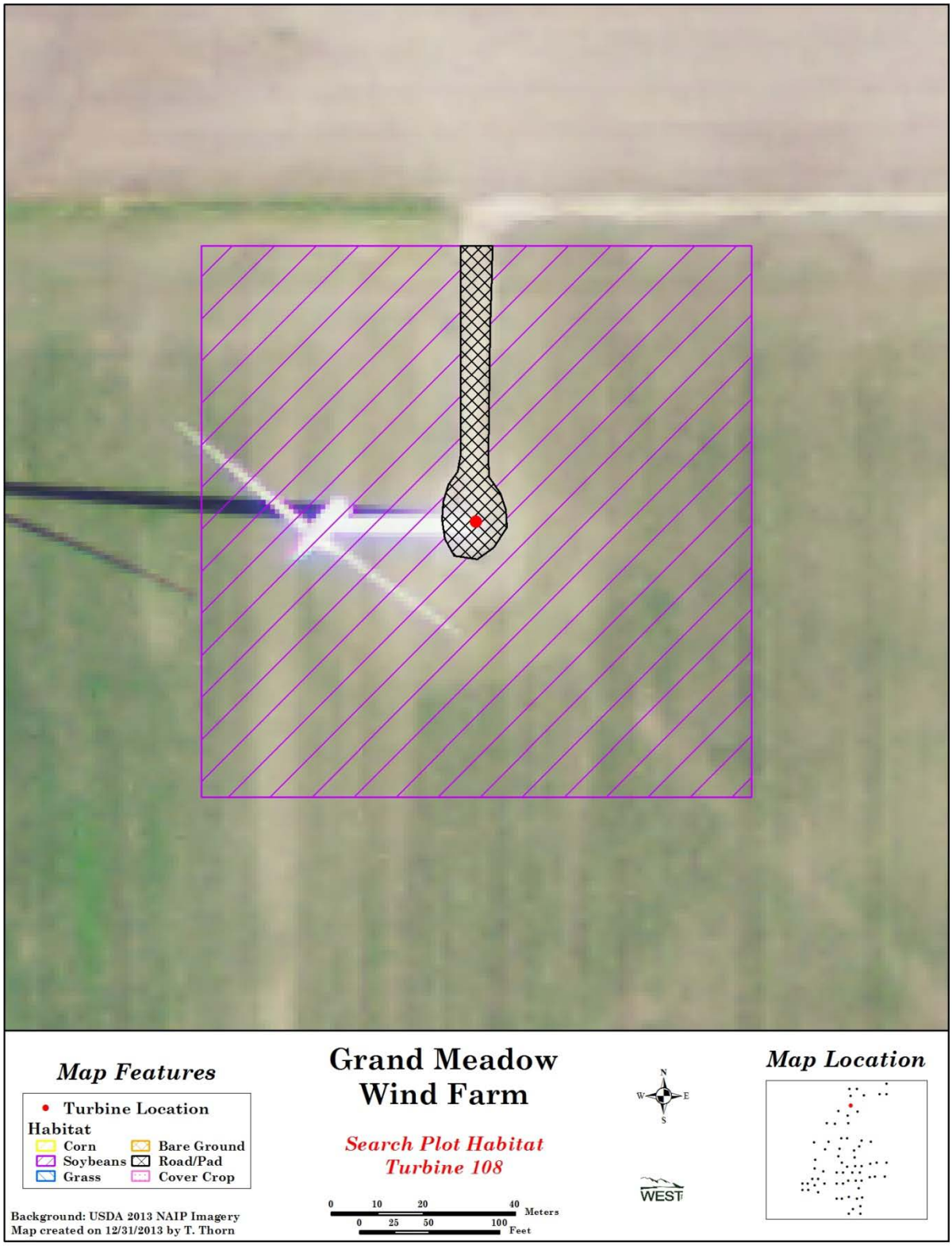
Appendix A-2. Habitat breakdown for turbine 154 at the Grand Meadow Wind Farm from July 12 – October 31, 2013.



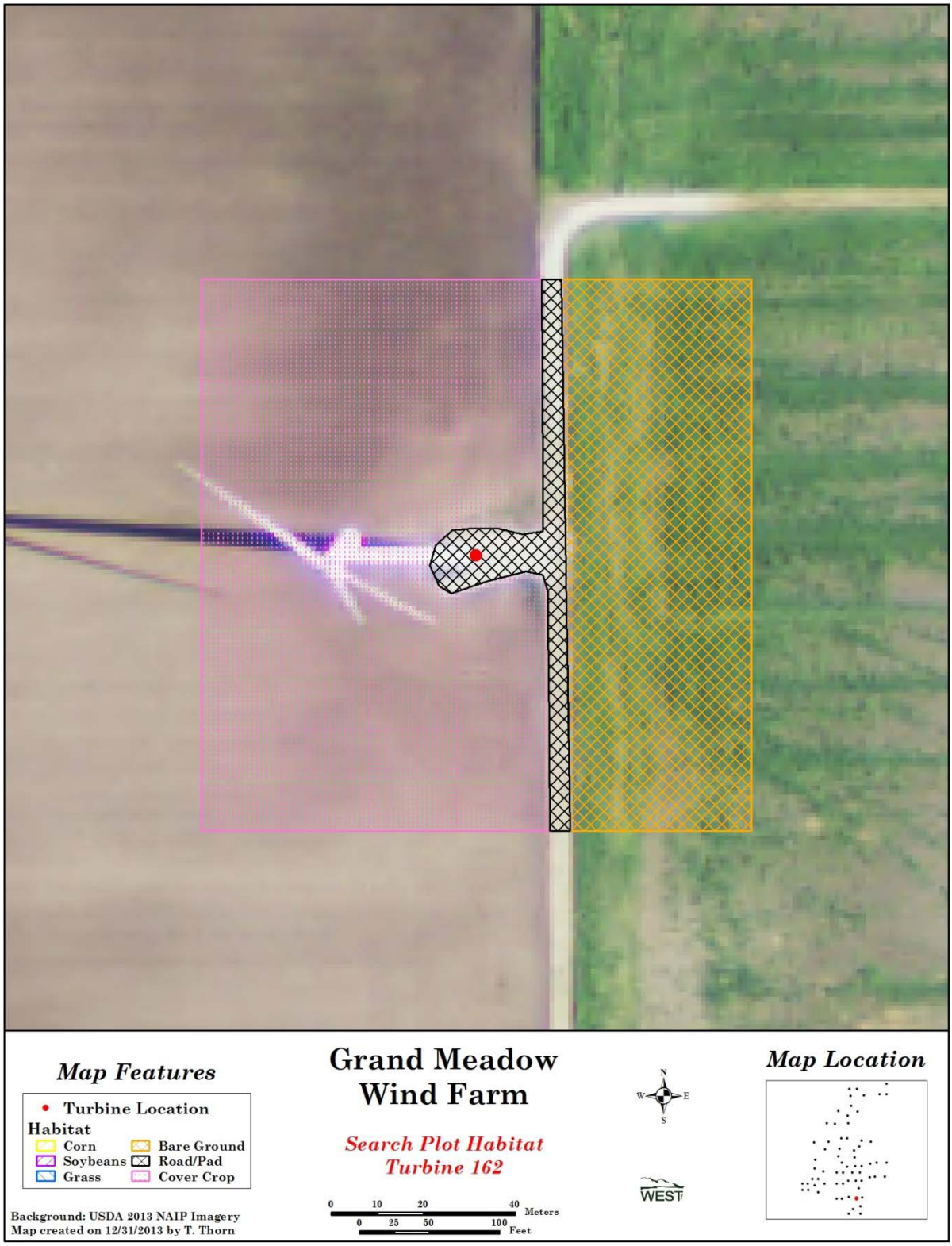
Appendix A-2. Habitat breakdown for turbine 108 at the Grand Meadow Wind Farm from July 12 – October 31, 2013.



Appendix A-2. Habitat breakdown for turbine 160 at the Grand Meadow Wind Farm from July 12 – October 31, 2013.



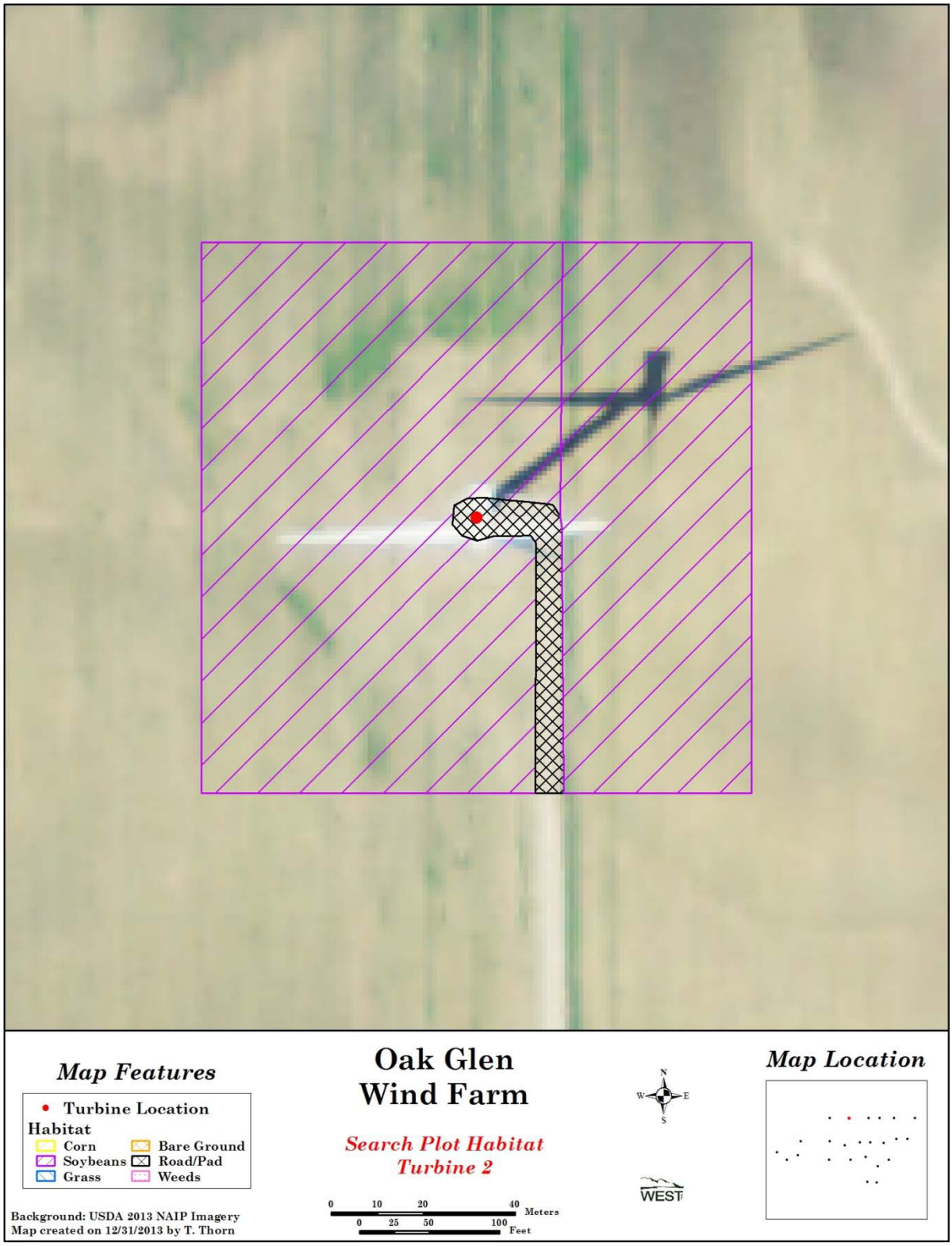
Appendix A-2. Habitat breakdown for turbine 108 at the Grand Meadow Wind Farm from July 12 – October 31, 2013.



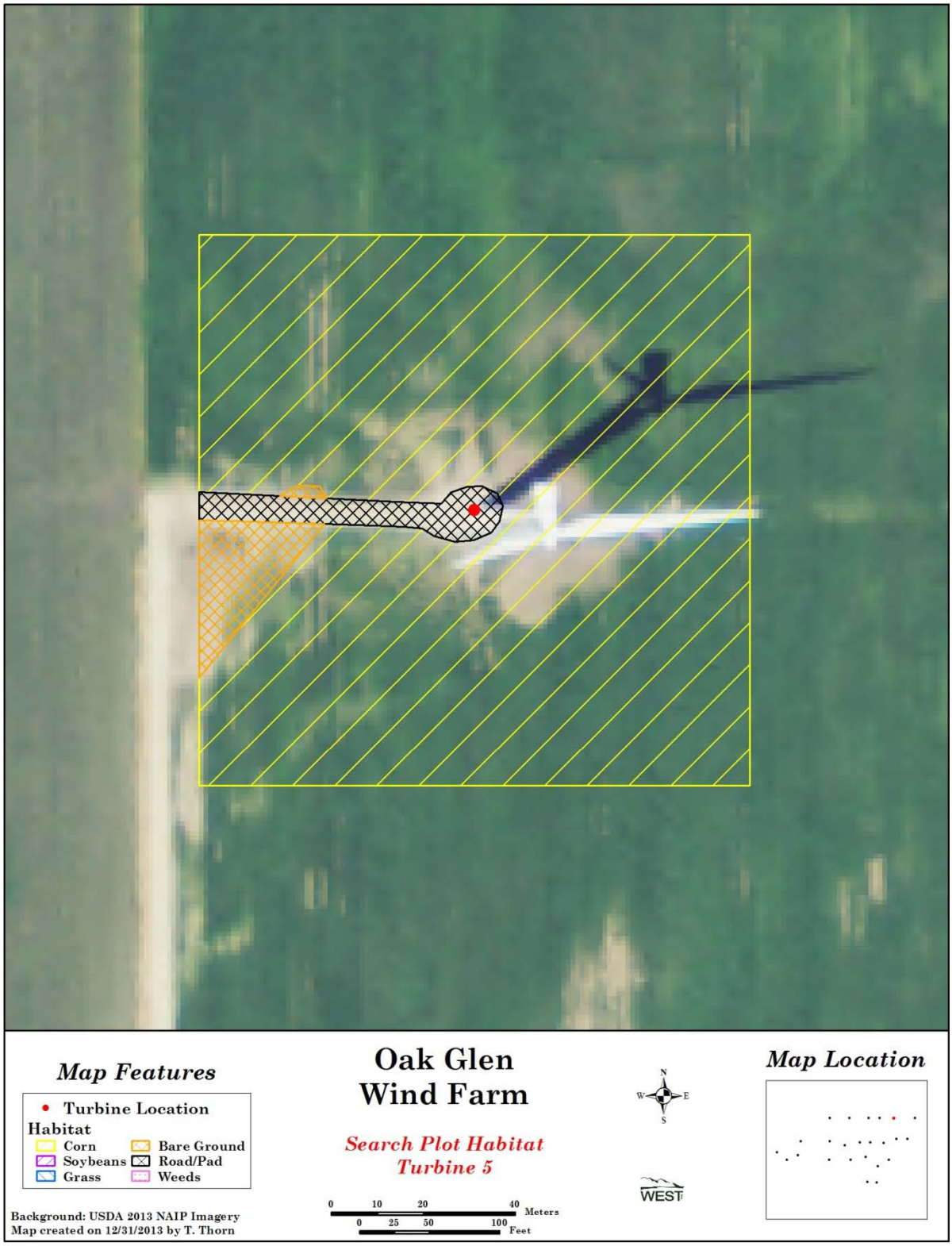
Appendix A-2. Habitat breakdown for turbine 162 at the Grand Meadow Wind Farm from July 12 – October 31, 2013.

Appendix A-3. Habitat breakdown and visibility class for turbines at the Oak Glen Wind Farm with full plots from July 15 – October 31, 2013.

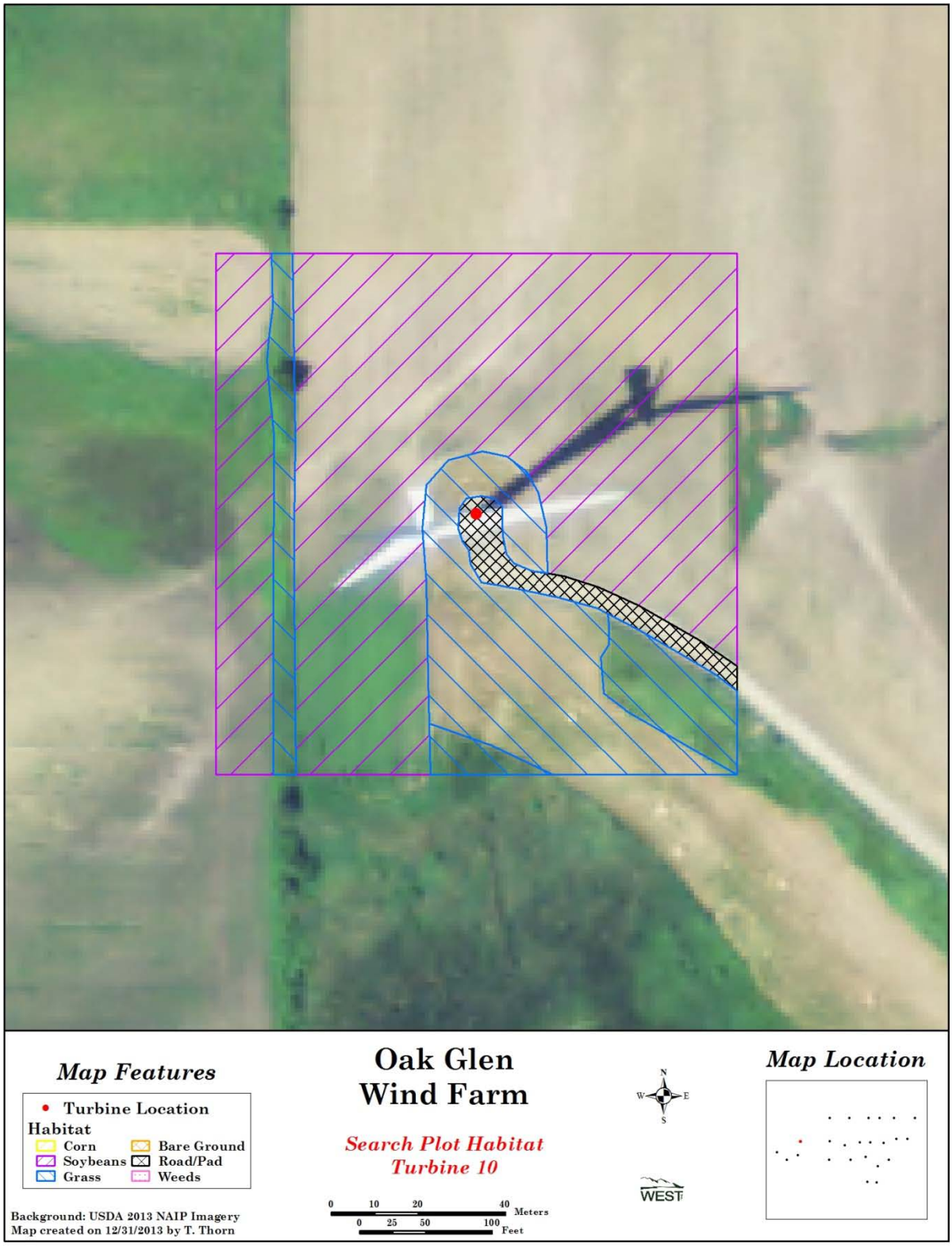
Turbine	Habitat	Date	Class	Date	Class	Date	Class	Acres
OG T-2	road/pad	7/3/2013	1	8/1/2013	1	10/17/2013	1	0.13
OG T-2	soybeans	7/3/2013	2	8/1/2013	4	10/17/2013	1	2.21
OG T-2	soybeans	7/3/2013	2	8/1/2013	4	10/17/2013	3	1.23
OG T-5	bare	7/3/2013	1	8/1/2013	1	10/17/2013	1	0.00
OG T-5	bare	7/3/2013	1	8/1/2013	1	10/17/2013	1	0.12
OG T-5	corn	7/3/2013	4	8/1/2013	4	10/17/2013	4	3.33
OG T-5	road/pad	7/3/2013	1	8/1/2013	1	10/17/2013	1	0.11
OG T-10	grass	7/3/2013	4	8/1/2013	4	10/17/2013	4	0.15
OG T-10	grass	7/3/2013	4	8/1/2013	4	10/17/2013	4	0.15
OG T-10	grass	7/3/2013	4	8/1/2013	4	10/17/2013	4	0.04
OG T-10	grass	7/3/2013	3	8/1/2013	4	10/17/2013	3	0.58
OG T-10	road/pad	7/3/2013	1	8/1/2013	1	10/17/2013	1	0.11
OG T-10	soybeans	7/3/2013	2	8/1/2013	4	10/17/2013	1	2.13
OG T-10	soybeans	7/3/2013	2	8/1/2013	4	10/17/2013	3	0.38
OG T-11	bare	7/3/2013	1	8/1/2013	1	10/17/2013	1	0.05
OG T-11	corn	7/3/2013	3	8/1/2013	4	10/17/2013	1	3.02
OG T-11	corn	7/3/2013	3	8/1/2013	4	10/17/2013	1	0.17
OG T-11	road/pad	7/3/2013	1	8/1/2013	1	10/17/2013	1	0.31
OG T-12	bare	7/3/2013	1	8/1/2013	1	10/17/2013	1	0.03
OG T-12	corn	7/3/2013	4	8/1/2013	4	10/17/2013	1	2.64
OG T-12	corn	7/3/2013	4	8/1/2013	4	10/17/2013	1	0.50
OG T-12	grass	7/3/2013	4	8/1/2013	4	10/17/2013	4	0.23
OG T-12	road/pad	7/3/2013	1	8/1/2013	1	10/17/2013	1	0.16
OG T-14	road/pad	---	---	---	1	10/17/2013	1	0.33
OG T-14	soybeans	---	---	---	4	10/17/2013	3	3.23
OG T-15	corn	7/3/2013	4	8/1/2013	4	10/17/2013	4	3.27
OG T-15	road/pad	7/3/2013	1	8/1/2013	1	10/17/2013	1	0.29
OG T-18	road/pad	7/3/2013	1	8/1/2013	1	10/17/2013	1	0.09
OG T-18	soybeans	7/3/2013	2	8/1/2013	4	10/17/2013	1	3.47
OG T-19	road/pad	7/3/2013	1	8/1/2013	1	10/17/2013	1	0.11
OG T-19	soybeans	7/3/2013	2	8/1/2013	4	10/17/2013	1	3.45
OG T-23	bare	7/3/2013	2	8/1/2013	1	10/17/2013	1	2.45
OG T-23	bare	7/3/2013	2	8/1/2013	1	10/17/2013	1	0.28
OG T-23	road/pad	7/3/2013	1	8/1/2013	1	10/17/2013	1	0.27
OG T-23	weeds	7/3/2013	4	8/1/2013	4	10/17/2013	4	0.56



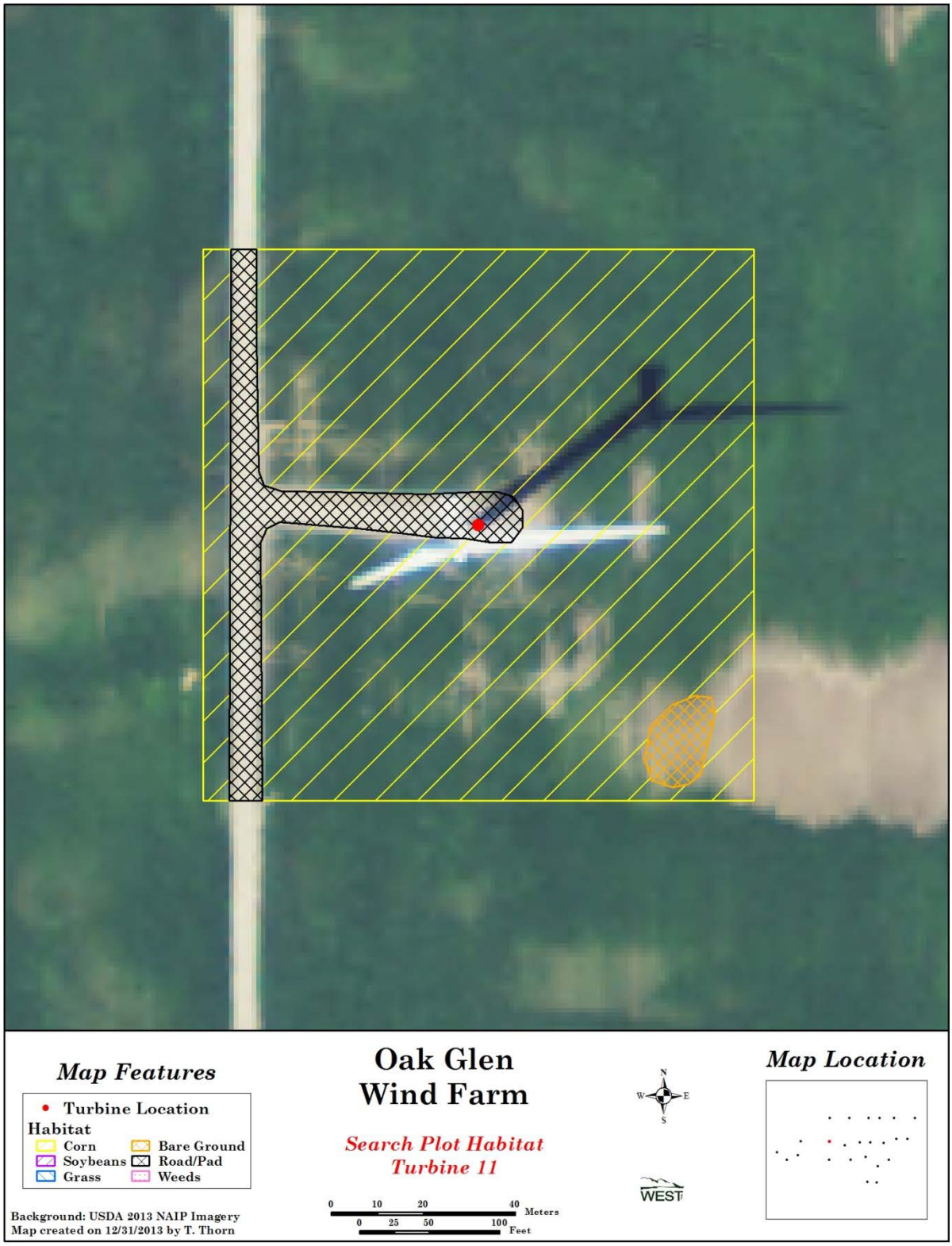
Appendix A-3. Habitat breakdown for turbine 2 at the Oak Glen Wind Farm from July 15 – October 31, 2013.



Appendix A-3. Habitat breakdown for turbine 5 at the Oak Glen Wind Farm from July 15 – October 31, 2013.

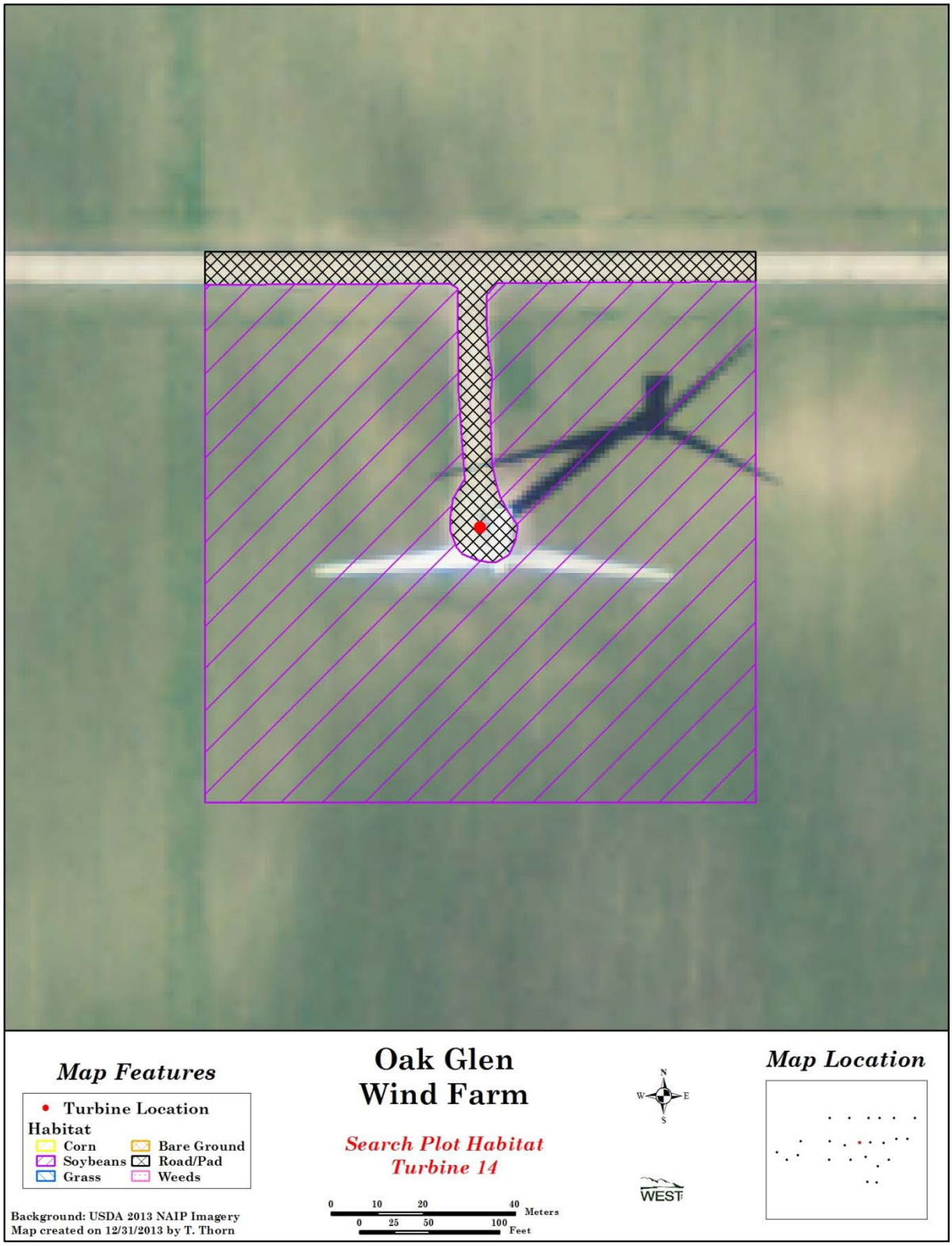


Appendix A-3. Habitat breakdown for turbine 10 at the Oak Glen Wind Farm from July 15 – October 31, 2013.

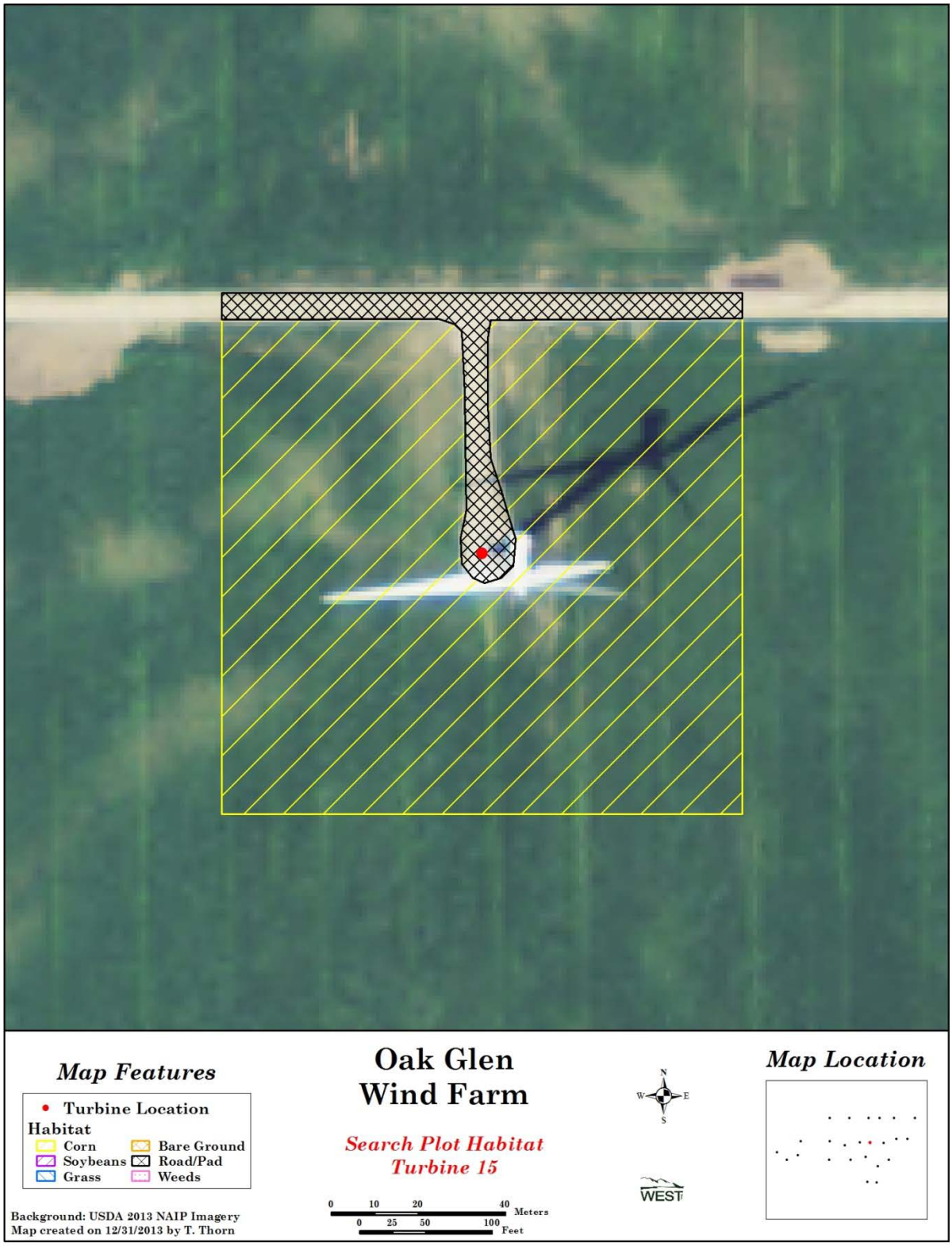


Appendix A-3. Habitat breakdown for turbine 11 at the Oak Glen Wind Farm from July 15 – October 31, 2013.

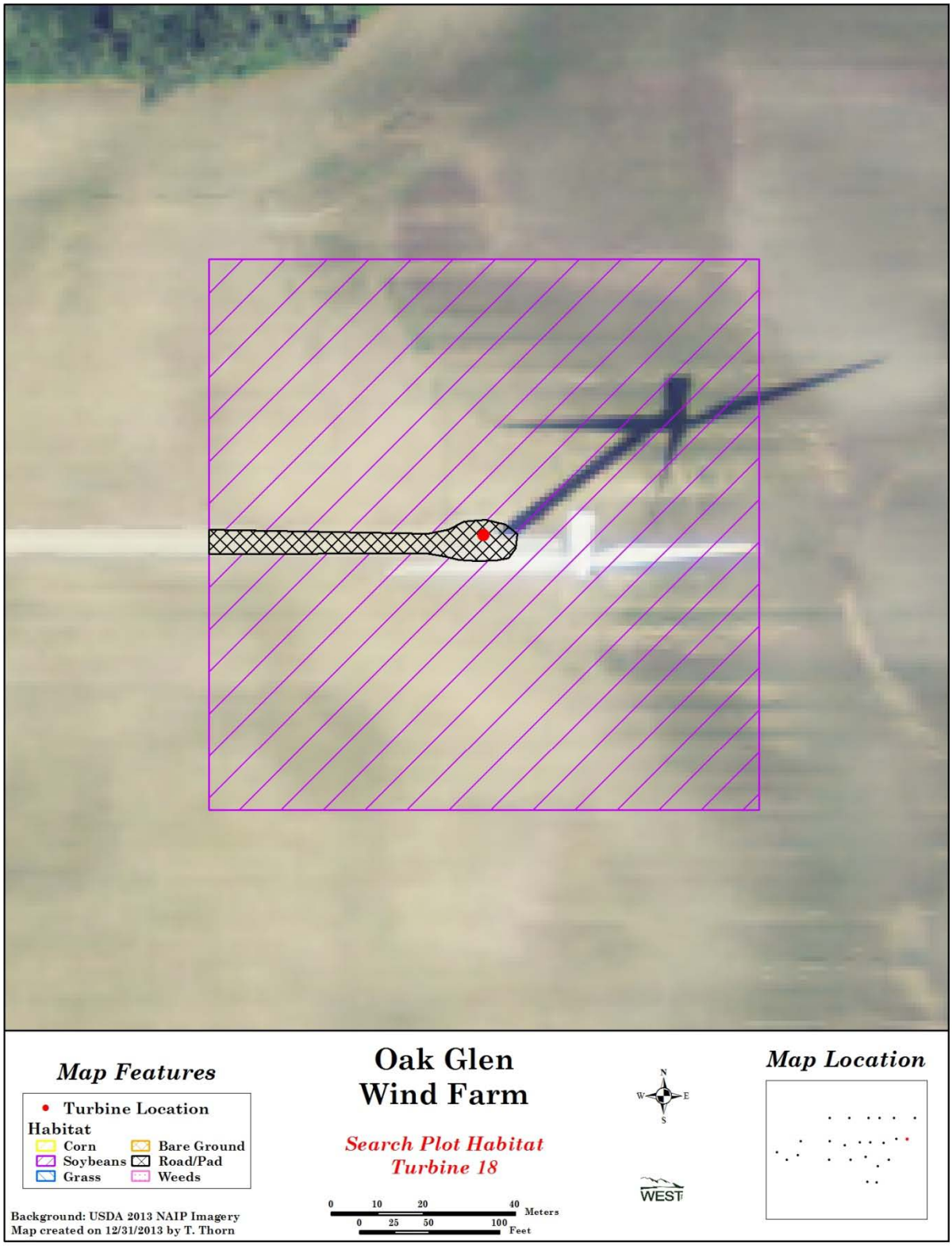
Appendix A-3. Habitat breakdown for turbine 12 at the Oak Glen Wind Farm from July 15 – October 31, 2013.



Appendix A-3. Habitat breakdown for turbine 14 at the Oak Glen Wind Farm from July 15 – October 31, 2013.

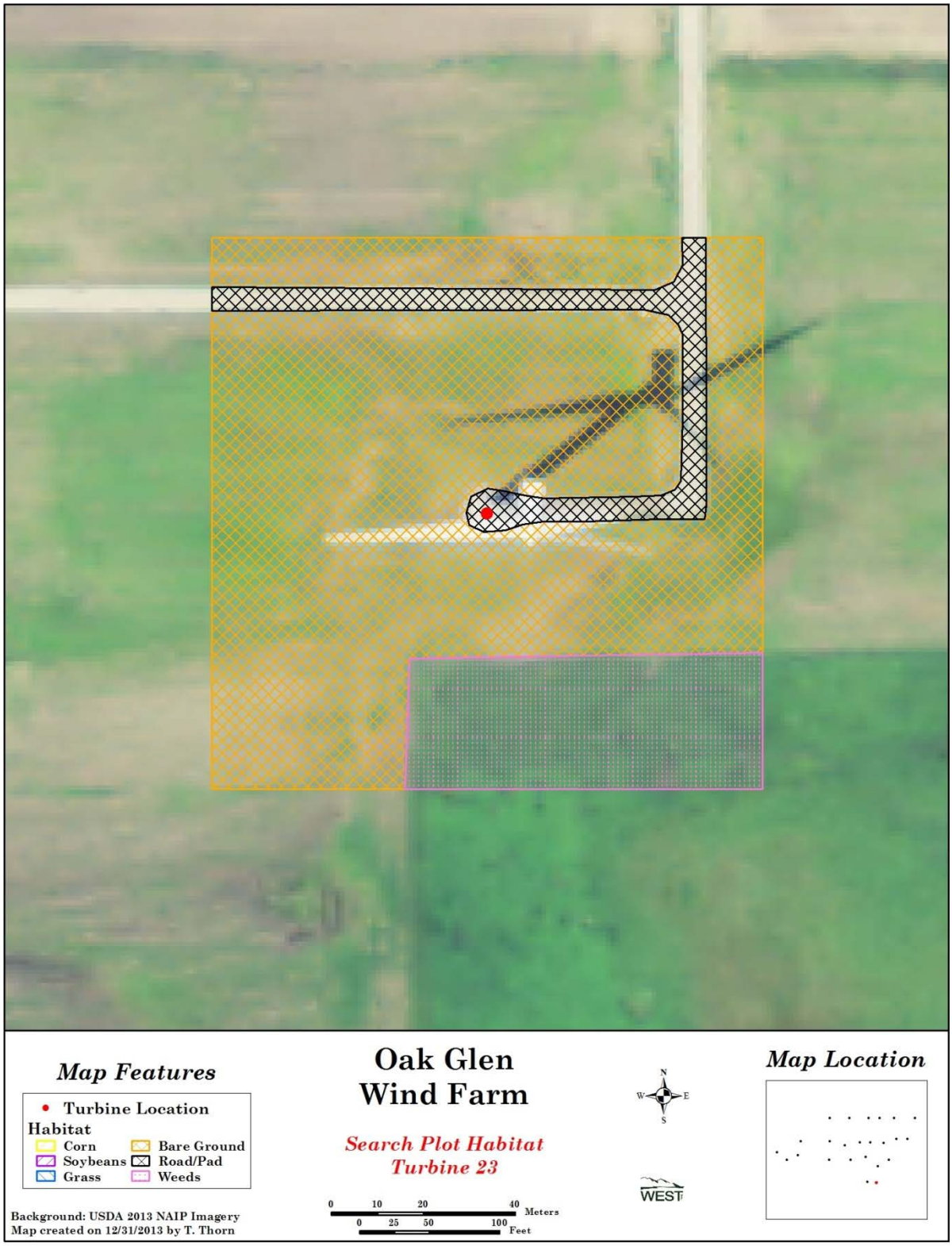


Appendix A-3. Habitat breakdown for turbine 15 at the Oak Glen Wind Farm from July 15 – October 31, 2013.



Appendix A-3. Habitat breakdown for turbine 18 at the Oak Glen Wind Farm from July 15 – October 31, 2013.

Appendix A-3. Habitat breakdown for turbine 19 at the Oak Glen Wind Farm from July 15 – October 31, 2013.



Appendix A-3. Habitat breakdown for turbine 23 at the Oak Glen Wind Farm from July 15 – October 31, 2013.

Appendix B. Summary of Search Area for Plots and Roads and Pads at Big Blue, Grand Meadow, and Oak Glen Wind Energy Facilities for 2013

Appendix B-1. Total area searched in 10-meter (m) bands for plots at the Big Blue, Grand Meadow, and Oak Glen wind energy facilities from July 9 – October 31, 2013.

Distance (m)	Big Blue			Grand Meadow			Oak Glen		
	Acres Searched	Total Acres	%	Acres Searched	Total Acres	%	Acres Searched	Total Acres	%
0-10	0.78	0.78	100	3.88	3.88	100	1.09	1.09	100
11-20	2.33	2.33	100	11.63	11.63	100	3.26	3.26	100
21-30	3.88	3.88	100	19.38	19.38	100	5.43	5.43	100
31-40	5.43	5.43	100	27.13	27.13	100	7.60	7.60	100
41-50	6.98	6.98	100	34.88	34.88	100	9.77	9.77	100
51-60	8.53	8.53	100	42.64	42.64	100	11.94	11.94	100
61-70	5.29	5.29	100	26.46	26.46	100	7.41	7.41	100
71-80	2.14	2.14	100	10.71	10.71	100	3.00	3.00	100
81-90	0.24	0.24	100	1.22	1.22	100	0.34	0.34	100

Appendix B-2. Total area searched in 10-meter (m) bands for roads and pads at the Big Blue, Grand Meadow, and Oak Glen wind energy facilities from July 9 – October 31, 2013.

Distance (m)	Big Blue			Grand Meadow			Oak Glen		
	Acres Searched	Total Acres	%	Acres Searched	Total Acres	%	Acres Searched	Total Acres	%
0-10	0.48	0.78	61.30	2.35	3.88	60.72	0.56	1.09	51.52
11-20	0.15	2.33	6.36	1.04	11.63	8.99	0.20	3.26	6.15
21-30	0.17	3.88	4.38	0.85	19.38	4.41	0.17	5.43	3.21
31-40	0.19	5.43	3.43	0.94	27.13	3.45	0.21	7.60	2.74
41-50	0.25	6.98	3.56	1.02	34.88	2.91	0.23	9.77	2.33
51-60	0.32	8.53	3.71	1.09	42.64	2.56	0.25	11.94	2.09
61-70	0.18	5.29	3.32	0.39	26.46	1.47	0.09	7.41	1.24
71-80	0.09	2.14	4.25	0.13	10.71	1.23	0.04	3.00	1.42
81-90	<0.01	0.24	0.32	0.00	1.22	0.04	0.01	0.34	1.79

Appendix C. Summary of Search Effort at the Big Blue, Grand Meadow, and Oak Glen Wind Energy Facilities for 2013

Appendix C-1. Summary of timing and number of searches for plots at the Big Blue Wind Farm from July 9 – October 31, 2013 (includes initial clearing search).

	Plots											Roads/Pads						
Date	1	3	4	7	8	11	12	13	14	16	18	2	5	6	9	10	15	17
07/09/13				1	1		1	1	1	1	1					1		
07/10/13	1	1	1	1			1	1	1	1	1	1	1	1	1	1	1	1
07/11/13		1	1	1	1	1	1		1	1	1							
07/12/13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
07/15/13	1	1	1	1	1	1	1		1		1							
07/16/13	1	1	1		1	1	1	1	1		1	1	1	1	1	1	1	1
07/17/13	1	1	1	1	1	1			1	1	1							
07/18/13	1	1	1	1		1		1	1	1	1	1	1	1		1	1	1
07/19/13	1	1	1	1		1			1	1	1							
07/22/13	1	1	1	1	1	1	1		1	1	1							
07/23/13	1	1		1		1	1	1	1	1	1	1	1			1	1	1
07/24/13	1	1	1	1	1	1	1		1	1	1							
07/25/13			1	1	1		1		1	1		1		1	1		1	1
07/26/13	1	1	1	1	1	1		1	1	1	1					1		
07/29/13	1	1			1	1		1	1		1			1	1		1	
07/30/13	1	1			1	1		1	1	1	1	1	1	1	1	1	1	1
07/31/13	1	1	1	1	1	1		1	1	1	1							
08/01/13	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1
08/02/13	1	1	1	1	1	1		1	1	1								
08/05/13	1	1	1	1	1	1		1	1	1	1							
08/06/13	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1
08/07/13	1	1	1	1		1			1	1	1							
08/08/13	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	
08/09/13	1	1	1	1	1	1		1	1	1	1							1
08/12/13	1	1	1	1	1	1			1	1	1							
08/13/13	1	1	1	1	1	1			1	1	1	1	1	1	1	1	1	1
08/14/13	1	1	1	1	1	1			1	1	1			1				
08/15/13		1		1						1	1		1	1			1	1
08/16/13	1			1		1			1			1				1		
08/19/13	1	1	1	1	1	1			1	1	1							
08/20/13	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1
08/21/13	1	1	1	1	1			1	1	1	1							
08/22/13		1	1	1	1	1			1	1	1							
08/23/13	1	1	1	1	1	1		1		1	1	1	1	1	1	1	1	1
08/26/13	1	1	1	1	1	1		1	1	1	1							
08/27/13	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	
08/28/13	1	1	1	1	1	1		1	1	1	1							
08/29/13	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1
08/30/13	1	1	1	1	1	1		1	1	1	1							
09/03/13	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1
09/04/13	1	1	1	1	1	1		1	1	1	1							
09/05/13	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1
09/06/13	1	1	1	1	1	1			1	1								
09/09/13	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1
09/10/13	1	1	1	1	1	1			1	1	1							
09/11/13	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1
09/12/13	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1
09/13/13	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1		1
09/16/13	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1
09/17/13	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1

Appendix C-1. Summary of timing and number of searches for plots at the Big Blue Wind Farm from July 9 – October 31, 2013 (includes initial clearing search).

	Plots											Roads/Pads						
Date	**1**	**3**	**4**	**7**	**8**	**11**	**12**	**13**	**14**	**16**	**18**	**2**	**5**	**6**	**9**	**10**	**15**	**17**
09/18/13	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1
09/19/13	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1
09/20/13	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1
09/23/13	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1
09/24/13	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1
09/25/13	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1
09/26/13	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1
09/27/13	1	1	1	1	1	1		1	1	1	1							
09/30/13	1	1	1	1	1	1		1	1	1	1							
10/01/13	1	1	1	1	1	1		1	1	1	1							
10/02/13	1	1	1	1	1			1	1	1	1	1	1	1	1	1	1	1
10/03/13	1	1	1	1	1	1		1	1	1	1							
10/04/13		1		1	1	1		1	1	1	1		1	1	1	1	1	1
10/07/13	1	1	1	1	1	1		1	1	1	1							
10/08/13	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1
10/09/13	1	1	1	1	1	1		1	1	1	1							
10/10/13	1	1	1	1		1		1	1	1	1							
10/11/13		1			1	1		1	1	1	1	1	1	1	1	1	1	1
10/14/13	1	1	1	1	1	1		1	1	1	1							
10/15/13			1	1	1	1		1	1	1								
10/16/13	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1
10/17/13	1	1		1	1	1		1		1	1							
10/18/13	1	1	1	1	1	1		1		1	1	1	1	1	1	1	1	1
10/21/13	1	1	1	1	1	1		1		1	1							
10/22/13	1	1	1	1	1			1	1	1	1							
10/23/13	1	1	1	1	1	1		1	1	1	1	1	1	1	1		1	1
10/24/13	1		1	1	1			1	1	1	1					1		
10/25/13	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1
10/28/13	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1
10/29/13	1	1	1	1	1	1		1	1		1							
10/30/13	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1
10/31/13	1	1	1		1	1		1	1	1	1							

Appendix C-2. Summary of timing and number of searches for plots at the Grand Meadow Wind Farm from July 12 – October 31, 2013 (includes initial clearing search).

Date	106	108	113	116	117	121	125	139	144	152	154	160	162
07/12/13					1		1	1	1	1			
07/15/13	1		1	1							1		
07/16/13												1	1
07/17/13	1	1	1	1	1		1					1	
07/18/13		1								1	1		1
07/19/13	1		1	1	1			1			1	1	
07/22/13	1	1	1	1	1				1		1		1
07/23/13	1		1	1	1	1	1	1			1	1	1
07/24/13	1		1	1	1	1		1	1	1	1	1	1
07/25/13						1	1			1		1	1
07/26/13	1	1	1	1	1			1	1		1	1	1
07/29/13	1	1	1	1	1	1	1			1		1	1
07/30/13	1	1	1	1	1	1	1	1	1	1	1	1	1
07/31/13		1		1	1	1	1	1	1	1	1	1	1
08/01/13	1	1		1	1	1	1	1	1	1	1	1	1
08/02/13	1	1	1	1	1	1	1	1	1		1	1	1
08/05/13	1	1		1	1		1			1		1	1
08/06/13	1	1		1	1	1		1	1			1	1
08/07/13	1	1	1	1	1	1	1	1	1	1	1	1	1
08/08/13	1	1	1			1	1	1	1	1	1		1
08/09/13	1	1		1	1	1	1	1	1	1	1	1	1
08/12/13	1	1	1		1	1	1	1	1	1	1	1	1
08/13/13	1	1			1	1	1	1	1	1		1	1
08/14/13	1	1	1		1	1	1	1	1	1	1	1	1
08/15/13	1	1	1	1		1	1	1	1	1	1	1	1
08/16/13	1	1	1	1		1	1	1	1	1	1	1	1
08/17/13													
08/19/13	1	1		1	1		1	1		1		1	
08/20/13	1	1	1	1	1	1	1	1	1	1	1	1	1
08/21/13	1	1		1	1	1		1	1	1	1	1	1
08/22/13	1	1	1	1	1	1		1	1	1	1	1	1
08/23/13	1	1	1	1	1	1		1	1	1	1	1	1
08/26/13	1	1	1	1	1	1		1	1	1	1	1	1
08/27/13	1	1	1	1	1	1	1	1	1	1	1	1	1
08/28/13	1	1		1			1			1			1
08/29/13	1	1		1	1		1	1		1		1	1
08/30/13	1	1		1	1		1			1		1	1
09/03/13	1	1	1	1	1	1	1	1	1			1	1
09/04/13	1	1	1	1	1		1		1			1	1
09/05/13	1	1		1	1		1	1				1	1
09/06/13	1	1		1	1	1	1	1				1	1
09/09/13		1		1									
09/10/13	1	1	1	1	1			1		1	1	1	1
09/11/13	1	1	1	1	1	1	1	1	1	1	1	1	1
09/12/13	1	1	1	1	1	1	1	1	1	1	1	1	1
09/13/13	1	1	1	1	1	1	1	1	1	1	1	1	1
09/16/13	1		1	1	1	1		1	1	1	1	1	1
09/17/13	1		1	1	1	1	1	1		1	1	1	1
09/18/13	1		1	1	1	1	1	1	1	1	1	1	1
09/19/13	1		1	1	1		1	1	1	1	1	1	1
09/20/13	1		1	1	1	1	1	1		1		1	1

Appendix C-2. Summary of timing and number of searches for plots at the Grand Meadow Wind Farm from July 12 – October 31, 2013 (includes initial clearing search).

Date	106	108	113	116	117	121	125	139	144	152	154	160	162
09/23/13	1	1	1	1	1	1	1	1	1	1	1	1	1
09/24/13	1	1	1	1	1	1	1	1	1	1	1	1	1
09/25/13	1	1	1	1	1	1	1	1	1	1	1	1	1
09/26/13	1	1		1	1	1		1	1	1	1	1	1
09/27/13	1	1			1	1	1	1	1	1	1	1	1
09/30/13		1	1	1	1		1	1		1	1	1	1
10/01/13	1	1	1	1	1	1	1	1	1		1		1
10/02/13	1	1	1	1	1	1	1	1		1	1		1
10/03/13	1								1				
10/04/13	1	1	1	1	1	1	1	1	1	1	1	1	1
10/07/13	1	1	1	1	1	1	1	1	1	1	1	1	1
10/08/13	1	1	1	1	1	1	1	1	1	1	1	1	1
10/09/13	1	1	1	1	1	1	1	1	1	1	1	1	1
10/10/13	1		1	1	1	1	1	1	1	1	1	1	
10/11/13	1	1		1	1	1	1	1				1	
10/14/13	1	1	1	1	1	1	1	1	1	1	1	1	1
10/15/13	1	1	1	1	1	1	1	1	1	1	1	1	1
10/16/13	1	1	1			1	1	1	1	1		1	1
10/17/13	1	1	1		1	1	1	1	1			1	1
10/18/13	1	1	1	1	1	1	1	1	1	1	1	1	1
10/21/13	1	1		1	1	1	1		1	1	1		1
10/22/13	1	1			1	1	1	1	1	1	1	1	1
10/23/13	1	1				1	1	1		1		1	1
10/24/13	1			1	1	1	1	1	1	1		1	1
10/25/13	1	1			1	1	1		1	1		1	1
10/28/13	1	1		1	1	1	1	1		1		1	
10/29/13	1	1			1	1	1	1		1			1
10/30/13		1					1	1		1	1	1	1
10/31/13		1					1	1			1	1	1

Appendix C-3. Summary of timing and number of searches at the Oak Glen Wind Farm from July 12 – October 31, 2013 (includes initial clearing search).

	Plots										Roads/Pads													
Date	2	5	10	11	12	14	15	18	19	23	1	3	4	6	7	8	9	13	16	17	20	21	22	24
07/15/13	1	1									1	1	1	1	1	1	1	1	1	1		1	1	1
07/16/13			1	1	1					1											1			
07/17/13						1	1	1	1															
07/18/13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
07/19/13	1	1	1	1	1	1	1	1	1	1														
07/22/13	1	1	1	1	1	1	1	1	1	1														
07/23/13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
07/24/13	1	1	1	1	1	1	1	1	1	1														
07/25/13	1	1		1	1	1	1				1	1	1	1	1	1	1	1	1		1	1		
07/26/13	1	1	1	1	1	1	1	1	1	1										1			1	1
07/29/13	1	1	1	1	1	1	1	1	1	1														
07/30/13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
07/31/13	1	1	1	1	1	1	1	1	1	1														
08/01/13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
08/02/13	1	1	1	1	1	1	1	1	1	1														
08/05/13	1	1	1	1	1	1	1	1	1	1		1												
08/06/13	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1
08/07/13	1	1	1	1	1	1	1	1	1	1														
08/08/13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
08/09/13	1	1	1	1	1	1	1	1	1	1														
08/12/13	1	1	1	1	1	1	1	1	1	1														
08/13/13	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1
08/14/13	1	1	1	1	1	1	1	1	1	1														
08/15/13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
08/16/13	1	1	1	1	1	1	1	1	1	1														
08/19/13	1	1	1	1	1	1	1	1	1	1														
08/20/13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1
08/21/13	1	1	1	1	1	1	1	1	1	1						1								
08/22/13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
08/23/13	1	1	1	1	1	1	1	1	1	1														
08/26/13	1	1	1	1	1	1	1	1	1	1														
08/27/13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
08/28/13	1	1	1	1	1	1	1	1	1	1														
08/29/13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Appendix C-3. Summary of timing and number of searches at the Oak Glen Wind Farm from July 12 – October 31, 2013 (includes initial clearing search).

	Plots										Roads/Pads													
Date	**2**	**5**	**10**	**11**	**12**	**14**	**15**	**18**	**19**	**23**	**1**	**3**	**4**	**6**	**7**	**8**	**9**	**13**	**16**	**17**	**20**	**21**	**22**	**24**
08/30/13	1	1	1	1	1	1	1	1	1	1														
09/03/13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1
09/04/13	1	1	1	1	1	1	1	1	1	1														
09/05/13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
09/06/13	1	1	1	1	1	1	1	1	1	1														
09/09/13	1	1	1	1	1	1	1	1	1	1														
09/10/13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
09/11/13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
09/12/13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
09/13/13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
09/16/13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
09/17/13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
09/18/13	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1
09/19/13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
09/20/13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
09/23/13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
09/24/13	1	1	1	1	1	1	1	1		1	1	1	1	1		1	1	1	1	1	1	1	1	
09/25/13	1	1		1	1		1			1														
09/26/13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
09/27/13	1	1	1	1	1	1	1	1	1	1														
09/30/13	1	1	1	1	1	1	1	1	1	1														
10/01/13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
10/02/13	1	1	1	1	1	1	1	1	1	1														
10/03/13	1	1		1	1	1	1	1	1	1		1	1	1				1	1	1	1	1	1	1
10/04/13	1	1	1	1	1	1	1	1	1	1														
10/07/13	1	1	1		1	1	1	1	1	1														
10/08/13	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
10/09/13	1	1	1	1	1	1	1	1	1	1														
10/10/13		1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
10/11/13	1	1	1	1	1	1	1		1	1														
10/14/13	1	1	1			1	1	1	1	1														
10/15/13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
10/16/13	1	1	1	1	1		1	1	1	1	1													
10/17/13	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1
10/18/13	1	1	1	1	1	1	1	1	1	1														

Appendix C-3. Summary of timing and number of searches at the Oak Glen Wind Farm from July 12 – October 31, 2013 (includes initial clearing search).

	Plots										Roads/Pads													
Date	**2**	**5**	**10**	**11**	**12**	**14**	**15**	**18**	**19**	**23**	**1**	**3**	**4**	**6**	**7**	**8**	**9**	**13**	**16**	**17**	**20**	**21**	**22**	**24**
10/21/13	1	1	1	1	1	1	1	1	1	1														
10/22/13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
10/23/13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1
10/24/13	1	1	1	1	1	1	1	1	1	1														
10/25/13	1	1	1	1	1	1	1	1	1	1														
10/28/13	1	1	1	1	1	1		1	1	1														
10/29/13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1
10/30/13	1	1	1	1	1	1	1	1	1	1														
10/31/13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1

Appendix D. Seasonal Bat and Bird Fatality Rate Estimations for Turbines with Plot Searches at the Big Blue Wind Farm from July 9 – October 31, 2013

Appendix D-1. Correction factors and bat and bird fatality rates by season using the Shoenfeld estimator for turbines with plot searches at the Big Blue Wind Farm from July 9 – October 31, 2013.

Parameter	Summer (10 turbines searched) Mean	Summer (10 turbines searched) CI	Fall (10 turbines searched) Mean	Fall (10 turbines searched) CI
Search Area Adjustment				
A (small birds)	1.00	-	1.37	-
A (large birds)	1.00	-	1.37	-
A (bats)	1.02	-	1.32	-
Observer detection Rate				
p (small birds)	0.33	0.08 - 0.58	0.33	0.08 - 0.58
p (large birds)	0.78	0.56 – 1.00	0.78	0.56 – 1.00
p (bats)	0.44	0.25 - 0.62	0.44	0.25 - 0.62
Mean Carcass Removal Time (Days)				
$\bar{t}$ (small birds)	6.45	4.63 - 9.36	6.45	4.63 - 9.36
$\bar{t}$ (large birds)	17.00	13.27 – 45.00	17.00	13.27 – 45.00
$\bar{t}$ (bats)	6.69	4.94 - 8.56	6.69	4.94 - 8.56
Observed Fatality Rates (Fatalities/Turbine/Season)				
small birds	0	-	0.30	0.10 - 0.60
large birds	0	-	0.10	0 - 0.30
bats	4.00	2.70 - 5.20	3.70	2.60 - 4.80
Average Probability of Carcass Availability and Detected				
small birds	0.62	0.27 - 0.78	0.62	0.27 - 0.78
large birds	0.93	0.89 - 0.98	0.93	0.89 - 0.98
bats	0.71	0.51 - 0.81	0.71	0.51 - 0.81
Adjusted Fatality Rates (Fatalities/Turbine/Seasons)				
small birds	0	-	0.66	0.18 - 1.62
large birds	0	-	0.15	0 - 0.43
bats	5.78	3.79 - 8.90	6.89	4.87 - 10.23

Overall Adjusted Fatality Rates (Fatalities/Turbine/Study Period)	**Mean**	**CI**
small birds	0.66	0.18 - 1.62
large birds	0.15	0 - 0.43
all birds	0.80	0.24 - 1.79
bats	12.67	9.55 - 18.22

Overall Adjusted Fatality Rates (Fatalities/MW/Study Period)	**Mean**	**CI**
small birds	0.33	0.09 - 0.81
large birds	0.07	0 - 0.21
all birds	0.40	0.12 - 0.90
bats	6.33	4.77 - 9.11

Appendix D-2. Correction factors and bat and bird fatality rates by season using the Huso estimator for turbines with plot searches at the Big Blue Wind Farm from July 9 – October 31, 2013.

	Summer (10 turbines searched)		Fall (10 turbines searched)	
Parameter	**Mean**	**CI**	**Mean**	**CI**
Search Area Adjustment				
A (small birds)	1.00	-	1.37	-
A (large birds)	1.00	-	1.37	-
A (bats)	1.02	-	1.32	-
Observer detection Rate				
p (small birds)	0.33	0.08 - 0.58	0.33	0.08 - 0.58
p (large birds)	0.78	0.56 – 1.00	0.78	0.56 – 1.00
p (bats)	0.44	0.25 - 0.62	0.44	0.25 - 0.62
Proportion of Carcasses Persisting Through the Interval				
r (small birds)	0.94	0.90 - 0.97	0.94	0.90 - 0.97
r (large birds)	0.98	0.96 - 0.99	0.98	0.96 - 0.99
r (bats)	0.94	0.89 - 0.97	0.94	0.89 - 0.97
Observed Fatality Rates (Fatalities/Turbine/Season)				
small birds	0	-	0.30	0.10 - 0.50
large birds	0	-	0.10	0 - 0.30
bats	1.40	0.60 - 2.3	2.00	1.40 - 2.60
Average Probability of Carcass Availability and Detected				
small birds	0.31	0.08 - 0.55	0.31	0.08 - 0.55
large birds	0.76	0.53 - 0.98	0.76	0.53 - 0.98
bats	0.41	0.23 - 0.60	0.41	0.23 - 0.60
Adjusted Fatality Rates (Fatalities/Turbine/Seasons)				
small birds	0	-	1.31	0.34 - 4.35
large birds	0	-	0.18	0 - 0.54
bats	3.48	1.31 - 7.87	6.42	3.68 - 13.19

Overall Adjusted Fatality Rates (Fatalities/Turbine/Study Period)		
	Mean	**CI**
small birds	1.31	0.34 - 4.35
large birds	0.18	0 - 0.54
all birds	1.49	0.36 - 4.49
bats	9.91	5.73 - 20.09

Overall Adjusted Fatality Rates (Fatalities/MW/Study Period)		
	Mean	**CI**
small birds	0.65	0.17 - 2.18
large birds	0.09	0 - 0.27
all birds	0.74	0.18 - 2.25
bats	4.95	2.87 - 10.05

Appendix D-3. Correction factors and bat and bird fatality rates by season using the Empirical Pi estimator for turbines with plot searches at the Big Blue Wind Farm from July 9 – October 31, 2013.

Parameter	Summer (10 turbines searched) Mean	Summer (10 turbines searched) CI	Fall (10 turbines searched) Mean	Fall (10 turbines searched) CI
Search Area Adjustment				
A (small birds)	1.00	-	1.37	-
A (large birds)	1.00	-	1.37	-
A (bats)	1.02	-	1.32	-
Observed Fatality Rates (Fatalities/Turbine/Season)				
small birds	0	-	0.30	0.10 - 0.60
large birds	0	-	0.10	0 - 0.30
bats	4.00	2.70 - 5.20	3.70	2.60 - 4.80
Average Probability of Carcass Availability and Detected				
small birds	0.50	0.25 - 0.75	0.50	0.25 - 0.75
large birds	0.89	0.67 – 1.00	0.89	0.67 – 1.00
bats	0.47	0.24 - 0.71	0.47	0.24 - 0.71
Adjusted Fatality Rates (Fatalities/Turbine/Seasons)				
small birds	0	-	0.82	0.21 - 2.19
large birds	0	-	0.15	0 - 0.46
bats	8.67	5.04 - 16.47	10.34	6.26 - 19.6

Overall Adjusted Fatality Rates (Fatalities/Turbine/Study Period)	**Mean**	**CI**
small birds	0.82	0.21 - 2.19
large birds	0.15	0 - 0.46
all birds	0.97	0.27 - 2.46
bats	19.01	12.25 - 35.28

Overall Adjusted Fatality Rates (Fatalities/MW/Study Period)	**Mean**	**CI**
small birds	0.41	0.11 - 1.09
large birds	0.08	0 - 0.23
all birds	0.49	0.14 - 1.23
bats	9.50	6.13 - 17.64

Appendix E. Seasonal Bat and Bird Fatality Rate Estimations at the Grand Meadow Wind Farm for Turbines with Plot Searches and Road and Pad Searches from July 12 – October 31, 2013

Appendix E-1. Correction factors and bat and bird fatality rates by season using the Shoenfeld estimator for turbines with plot searches at the Grand Meadow Wind Farm from July 12 – October 31, 2013.

Parameter	Summer (13 turbines searched) Mean	Summer (13 turbines searched) CI	Fall (13 turbines searched) Mean	Fall (13 turbines searched) CI
Search Area Adjustment				
A (small birds)	1.00	-	1.52	-
A (large birds)	1.00	-	1.37	-
A (bats)	1.00	-	1.00	-
Observer detection Rate				
p (small birds)	0.30	0.10 - 0.60	0.30	0.10 - 0.60
p (large birds)	0.50	0.25 - 0.75	0.50	0.25 - 0.75
p (bats)	0.36	0.18 - 0.55	0.36	0.18 - 0.55
Mean Carcass Removal Time (Days)				
$\bar{t}$ (small birds)	11.03	7.36 - 17.04	11.03	7.36 - 17.04
$\bar{t}$ (large birds)	10.88	7.10 - 16.74	10.88	7.10 - 16.74
$\bar{t}$ (bats)	5.85	4.87 - 6.76	5.85	4.87 - 6.76
Observed Fatality Rates (Fatalities/Turbine/Season)				
small birds	0.08	0 - 0.23	0.31	0.08 - 0.62
large birds	0		0	-
bats	1.08	0.15 - 2.15	1.23	0.77 - 1.77
Average Probability of Carcass Availability and Detected				
small birds	0.69	0.34 - 0.85	0.69	0.34 - 0.85
large birds	0.80	0.62 - 0.89	0.80	0.62 - 0.89
bats	0.59	0.41 - 0.71	0.59	0.41 - 0.71
Adjusted Fatality Rates (Fatalities/Turbine/Seasons)				
small birds	0.11	0 - 0.37	0.68	0.15 - 1.69
large birds	0	-	0	-
bats	1.82	0.26 - 4.18	2.84	1.68 - 4.76

Overall Adjusted Fatality Rates (Fatalities/Turbine/Study Period)	**Mean**	**CI**
small birds	0.79	0.24 - 1.88
large birds	0	-
all birds	0.79	0.24 - 1.88
bats	4.66	2.73 - 8.03

Overall Adjusted Fatality Rates (Fatalities/MW/Study Period)	**Mean**	**CI**
small birds	0.53	0.16 - 1.25
large birds	0	-
all birds	0.53	0.16 - 1.25
bats	3.11	1.82 - 5.36

Appendix E-2. Correction factors and bat and bird fatality rates by season using the Huso estimator for turbines with plot searches at the Grand Meadow Wind Farm from July 12 – October 31, 2013.

Parameter	Summer (13 turbines searched) Mean	Summer (13 turbines searched) CI	Fall (13 turbines searched) Mean	Fall (13 turbines searched) CI
Search Area Adjustment				
A (small birds)	1.00	-	1.52	-
A (large birds)	1.00	-	1.37	-
A (bats)	1.00	-	1.00	-
Observer detection Rate				
p (small birds)	0.30	0.10 - 0.60	0.30	0.10 - 0.60
p (large birds)	0.50	0.25 - 0.75	0.50	0.25 - 0.75
p (bats)	0.36	0.18 - 0.55	0.36	0.18 - 0.55
Proportion of Carcasses Persisting Through the Interval				
r (small birds)	0.96	0.93 - 0.98	0.96	0.93 - 0.98
r (large birds)	0.96	0.93 - 0.98	0.96	0.93 - 0.98
r (bats)	0.92	0.89 - 0.95	0.92	0.89 - 0.95
Observed Fatality Rates (Fatalities/Turbine/Season)				
small birds	0.08	0 - 0.23	0.15	0 - 0.31
large birds	0	-	0	-
bats	0.69	0.15 - 1.38	0.92	0.46 - 1.46
Average Probability of Carcass Availability and Detected				
small birds	0.29	0.09 - 0.56	0.29	0.09 - 0.56
large birds	0.48	0.24 - 0.71	0.48	0.24 - 0.71
bats	0.33	0.17 - 0.50	0.33	0.17 - 0.50
Adjusted Fatality Rates (Fatalities/Turbine/Seasons)				
small birds	0.27	0 - 1.20	0.81	0 - 3.60
large birds	0	-	0	-
bats	2.07	0.52 - 5.37	3.77	1.71 - 8.28

Overall Adjusted Fatality Rates (Fatalities/Turbine/Study Period)	**Mean**	**CI**
small birds	1.08	0.20 - 3.81
large birds	0	-
all birds	1.08	0.20 - 3.81
bats	5.84	2.98 - 12.25

Overall Adjusted Fatality Rates (Fatalities/MW/Study Period)	**Mean**	**CI**
small birds	0.72	0.14 - 2.54
large birds	0	-
all birds	0.72	0.14 - 2.54
bats	3.89	1.99 - 8.17

Appendix E-3. Correction factors and bat and bird fatality rates by season using the Empirical Pi estimator for turbines with plot searches at the Grand Meadow Wind Farm from July 12 – October 31, 2013.

Parameter	Summer (13 turbines searched) Mean	Summer (13 turbines searched) CI	Fall (13 turbines searched) Mean	Fall (13 turbines searched) CI
Search Area Adjustment				
A (small birds)	1.00	-	1.52	-
A (large birds)	1.00	-	1.37	-
A (bats)	1.00	-	1.00	-
Observed Fatality Rates (Fatalities/Turbine/Season)				
small birds	0.08	0 - 0.23	0.31	0.08 - 0.62
large birds	0	-	0	-
bats	1.08	0.15 - 2.15	1.23	0.77 - 1.77
Average Probability of Carcass Availability and Detected				
small birds	0.45	0.18 - 0.73	0.45	0.18 - 0.73
large birds	0.83	0.67 – 1.00	0.83	0.67 – 1.00
bats	0.50	0.33 - 0.72	0.50	0.33 - 0.72
Adjusted Fatality Rates (Fatalities/Turbine/Seasons)				
small birds	0.17	0 - 0.63	1.03	0.18 - 2.89
large birds	0	-	0	-
bats	2.15	0.35 - 4.75	3.37	1.74 – 6.00

Overall Adjusted Fatality Rates (Fatalities/Turbine/Study Period)	**Mean**	**CI**
small birds	1.20	0.32 - 3.28
large birds	0	-
all birds	1.20	0.32 - 3.28
bats	5.52	2.86 - 10.03

Overall Adjusted Fatality Rates (Fatalities/MW/Study Period)	**Mean**	**CI**
small birds	0.80	0.21 - 2.19
large birds	0	-
all birds	0.80	0.21 - 2.19
bats	3.68	1.91 - 6.69

Appendix E-4. Correction factors and bat fatality rates by season using the Shoenfeld estimator for turbines with road and pad searches at the Grand Meadow Wind Farm from July 12 – October 31, 2013.

Parameter	Summer (54 turbines searched) Mean	CI	Fall (54 turbines searched) Mean	CI
Search Area Adjustment				
A (bats)	5.81	-	5.81	-
Observer detection Rate				
p (bats)	0.13	0 – 0.27	0.13	0 – 0.27
Mean Carcass Removal Time (Days)				
$\bar{t}$ (bats)	5.81	4.87 – 6.75	5.81	4.87 – 6.75
Observed Fatality Rates (Fatalities/Turbine/Season)				
bats	0.13	0.06 – 0.22	0.59	0.41 – 0.80
Average Probability of Carcass Availability and Detected				
bats	0.20	0 - 0.37	0.20	0 - 0.37
Adjusted Fatality Rates (Fatalities/Turbine/Seasons)				
bats	3.86	1.20 – 10.11	17.63	8.54 – 40.50
Overall Adjusted Fatality Rates (Fatalities/Turbine/Study Period)				
	Mean		**CI**	
bats	21.48		10.37 – 47.22	
Overall Adjusted Fatality Rates (Fatalities/MW/Study Period)				
	Mean		**CI**	
bats	14.32		6.91 – 31.48	

Appendix F. Seasonal Bat and Bird Fatality Rate Estimations at the Oak Glen Wind Farm from July 15 – October 31, 2013

Appendix F-1. Correction factors and bat and bird fatality rates by season using the Shoenfeld estimator for turbines with plot searches at the Oak Glen Wind Farm from July 15 – October 31, 2013.

Parameter	Summer (10 turbines searched) Mean	Summer (10 turbines searched) CI	Fall (10 turbines searched) Mean	Fall (10 turbines searched) CI
Search Area Adjustment				
A (small birds)	1.00	-	1.36	-
A (large birds)	1.00	-	1.00	-
A (bats)	1.00	-	1.32	-
Observer detection Rate				
p (small birds)	0.45	0.18 - 0.73	0.45	0.18 - 0.73
p (large birds)	0.50	0.20 - 0.80	0.50	0.20 - 0.80
p (bats)	0.23	0.12 - 0.38	0.23	0.12 - 0.38
Mean Carcass Removal Time (Days)				
$\bar{t}$ (small birds)	5.80	3.98 - 8.05	5.80	3.98 - 8.05
$\bar{t}$ (large birds)	11.17	7.45 - 16.33	11.17	7.45 - 16.33
$\bar{t}$ (bats)	8.49	6.93 - 10.40	8.49	6.93 - 10.40
Observed Fatality Rates (Fatalities/Turbine/Season)				
small birds	0.10	0 - 0.30	0.40	0.10 - 0.70
large birds	0	-	0	-
bats	1.50	0.90 - 2.20	1.40	0.70 - 2.20
Average Probability of Carcass Availability and Detected				
small birds	0.70	0.44 - 0.82	0.70	0.44 - 0.82
large birds	0.83	0.66 - 0.92	0.83	0.66 - 0.92
bats	0.60	0.37 - 0.73	0.60	0.37 - 0.73
Adjusted Fatality Rates (Fatalities/Turbine/Seasons)				
small birds	0.14	0 - 0.44	0.78	0.32 - 1.54
large birds	0	-	0	-
bats	2.49	1.45 - 4.64	3.07	1.43 - 6.02

Overall Adjusted Fatality Rates (Fatalities/Turbine/Study Period)	**Mean**	**CI**
small birds	0.92	0.39 - 1.82
large birds	0	-
all birds	0.92	0.39 - 1.82
bats	5.56	3.59 - 9.61

Overall Adjusted Fatality Rates (Fatalities/MW/Study Period)	**Mean**	**CI**
small birds	0.51	0.22 - 1.01
large birds	0	-
all birds	0.51	0.22 - 1.01
bats	3.09	1.99 - 5.34

Appendix F-2. Correction factors and bat and bird fatality rates by season using the Huso estimator for turbines with plot searches at the Oak Glen Wind Farm from July 15 – October 31, 2013.

Parameter	Summer (10 turbines searched) Mean	Summer (10 turbines searched) CI	Fall (10 turbines searched) Mean	Fall (10 turbines searched) CI
Search Area Adjustment				
A (small birds)	1.00	-	1.36	-
A (large birds)	1.00	-	1.00	-
A (bats)	1.00	-	1.32	-
Observer detection Rate				
p (small birds)	0.45	0.18 - 0.73	0.45	0.18 - 0.73
p (large birds)	0.50	0.20 - 0.80	0.50	0.20 - 0.80
p (bats)	0.23	0.12 - 0.38	0.23	0.12 - 0.38
Proportion of Carcasses Persisting Through the Interval				
r (small birds)	0.93	0.88 - 0.96	0.93	0.88 - 0.96
r (large birds)	0.96	0.94 - 0.98	0.96	0.94 - 0.98
r (bats)	0.95	0.93 - 0.97	0.95	0.93 - 0.97
Observed Fatality Rates (Fatalities/Turbine/Season)				
small birds	0	-	0.40	0.20 - 0.70
large birds	0	-	0	-
bats	0.90	0.40 - 1.50	0.60	0.20 – 1.00
Average Probability of Carcass Availability and Detected				
small birds	0.42	0.17 - 0.66	0.42	0.17 - 0.66
large birds	0.48	0.19 - 0.77	0.48	0.19 - 0.77
bats	0.22	0.11 - 0.36	0.22	0.11 - 0.36
Fatality Rates (Fatalities/Turbine/Season)				
small birds	0	-	1.29	0.43 - 3.24
large birds	0	-	0	-
bats	4.10	1.55 - 10.07	3.60	0.94 - 9.58

Overall Adjusted Fatality Rates (Fatalities/Turbine/Study Period)	**Mean**	**CI**
small birds	1.29	0.43 - 3.2
large birds	0	-
all birds	1.29	0.43 - 3.2
bats	7.71	3.46 - 19.61

Overall Adjusted Fatality Rates (Fatalities/Turbine/Study Period)	**Mean**	**CI**
small birds	0.72	0.24 - 1.80
large birds	0	-
all birds	0.72	0.24 - 1.80
bats	4.28	1.92 - 10.90

Appendix F-3. Correction factors and bat and bird fatality rates by season using the Empirical Pi estimator for turbines with plot searches at the Oak Glen Wind Farm from July 15 – October 31, 2013.

Parameter	Summer (10 turbines searched) Mean	Summer (10 turbines searched) CI	Fall (10 turbines searched) Mean	Fall (10 turbines searched) CI
Search Area Adjustment				
A (small birds)	1.00	-	1.36	-
A (large birds)	1.00	-	1.00	-
A (bats)	1.00	-	1.32	-
Observed Fatality Rates (Fatalities/Turbine/Season)				
small birds	0.10	0 - 0.30	0.40	0.10 - 0.70
large birds	0	-	0	-
bats	1.50	0.90 - 2.20	1.40	0.70 - 2.20
Average Probability of Carcass Availability and Detected				
small birds	0.70	0.50 – 0.90	0.70	0.50 – 0.90
large birds	0.78	0.56 – 1.00	0.78	0.56 – 1.00
bats	0.59	0.41 - 0.77	0.59	0.41 - 0.77
Adjusted Fatality Rates (Fatalities/Turbine/Season)				
small birds	0.14	0 - 0.43	0.78	0.28 - 1.58
large birds	0	-	0	-
bats	2.54	1.42 - 4.22	3.12	1.45 - 5.54

Overall Adjusted Fatality Rates (Fatalities/Turbine/Study Period)	**Mean**	**CI**
small birds	0.92	0.38 - 1.73
large birds	0	-
all birds	0.90	0.38 - 1.85
bats	5.66	3.47 - 9.18

Overall Adjusted Fatality Rates (Fatalities/Turbine/Study Period)	**Mean**	**CI**
small birds	0.51	0.21 – 0.96
large birds	0	-
all birds	0.50	0.21 - 1.03
bats	3.15	1.93 - 5.10

Appendix G. North American Bat Fatality Summary Table

Appendix G. Comparable activity and fatality data for bats for the Shoenfeld estimator from publicly-available studies at wind energy facilities in North America, separated by geographic region.

Wind Energy Facility	Bat Activity Estimate[A]	Bat Activity Dates	Fatality Estimate[B]	No. of Turbines	Total MW
Big Blue, MN			11.15	**18**	**36**
Grand Meadow, MN			5.84	**67**	**100.5**
Oak Glen, MN			4.71	**24**	**36**
		Midwest			
Cedar Ridge, WI (2009)	9.97[C,D,E,F]	7/16/07-9/30/07	30.61	41	67.6
Blue Sky Green Field, WI	7.7[F]	7/24/07-10/29/07	24.57	88	145
Cedar Ridge, WI (2010)	9.97[C,D,E,F]	7/16/07-9/30/07	24.12	41	68
Fowler I, II, III, IN (2011)			20.19	355	600
Fowler I, II, III, IN (2010)			18.96	355	600
Forward Energy Center, WI	6.97	8/5/08-11/08/08	18.17	86	129
Harrow, Ont (2010)			11.13	24 (4, 6-turb facilities)	39.6
Top of Iowa, IA (2004)	35.7	5/26/04-9/24/04	10.27	89	80
Pioneer Prairie I, IA (Phase II)			10.06	62	102.3
Fowler I, IN (2009)			8.09	162	301
Crystal Lake II, IA			7.42	80	200
Top of Iowa, IA (2003)			7.16	89	80
Kewaunee County, WI			6.45	31	20.46
Ripley, Ont (2008)			4.67	38	76
Winnebago, IA			4.54	10	20
Buffalo Ridge, MN (Phase II; 2001/Lake Benton I)	2.2[D]	6/15/01-9/15/01	4.35	143	107.25
Buffalo Ridge, MN (Phase III; 2001/Lake Benton II)	2.2[D]	6/15/01-9/15/01	3.71	138	103.5
Crescent Ridge, IL			3.27	33	49.5
Fowler I, II, III, IN (2012)			2.96	355	600
Elm Creek II, MN			2.81	62	148.8
Buffalo Ridge II, SD (2011)			2.81	105	210
Buffalo Ridge, MN (Phase III; 1999)			2.72	138	103.5
Buffalo Ridge, MN (Phase II; 1999)			2.59	143	107.25
Moraine II, MN			2.42	33	49.5
Buffalo Ridge, MN (Phase II; 1998)			2.16	143	107.25
Prairie Winds (Minot), ND			2.13	80	115.5
Grand Ridge, IL			2.10	66	99
Barton I & II, IA			1.85	80	160
Fowler III, IN (2009)			1.84	60	99
Buffalo Ridge, MN (Phase III; 2002/Lake Benton II)	1.9[D]	6/15/02-9/15/02	1.81	138	103.5
Buffalo Ridge, MN (Phase II; 2002/Lake Benton I)	1.9[D]	6/15/02-9/15/02	1.64	143	107.25
Rugby, ND			1.60	71	149
Elm Creek, MN			1.49	67	100
Wessington Springs, SD (2009)			1.48	34	51
PrairieWinds ND1 (Minot), ND 2011			1.39	80	115.5
PrairieWinds SD1 (Crow Lake), SD			1.23	108	162
NPPD Ainsworth, NE			1.16	36	20.5
Buffalo Ridge, MN (Phase I; 1999)			0.74	73	25
Wessington Springs, SD (2010)			0.41	34	51
Buffalo Ridge I, SD (2010)			0.16	24	50.4

Appendix G. Comparable activity and fatality data for bats for the Shoenfeld estimator from publicly-available studies at wind energy facilities in North America, separated by geographic region.

Wind Energy Facility	Bat Activity Estimate[A]	Bat Activity Dates	Fatality Estimate[B]	No. of Turbines	Total MW
		Southern Plains			
Barton Chapel, TX			3.06	60	120
Big Smile, OK			2.90	66	132
Buffalo Gap II, TX			0.14	155	233
Red Hills, OK			0.11	82	123
Buffalo Gap I, TX			0.10	67	134
		Southeast			
Buffalo Mountain, TN (2005)			39.70	18	28.98
Buffalo Mountain, TN (2000-2003)	23.7[E]		31.54	3	1.98
		Northeast			
Mountaineer, WV (2003)			31.69	44	66
Mount Storm, WV (2009)	30.09	7/15/09-10/7/09	24.32	132	264
Noble Wethersfield, NY			16.30	84	126
Criterion, MD (2011)			15.61	28	70
Mount Storm, WV (2010)	36.67[G]	4/18/10-10/15/10	15.18	132	264
Locust Ridge, PA (Phase II; 2010)			14.38	51	102
Locust Ridge, PA (Phase II; 2009)			14.11	51	102
Casselman, PA (Spring & Fall 2008)			12.61	23	34.5
Maple Ridge, NY (2006)			11.21	120	198
Cohocton/Dutch Hills, NY (2010)			10.32	50	125
Maple Ridge, NY (2007)			9.42	195	321.75
Cohocton/Dutch Hill, NY (2009)			8.62	50	125
Casselman, PA (2009)			8.60	23	34.5
Noble Bliss, NY (2008)			7.80	67	100
Criterion, MD (2012)			7.62	28	70
Mount Storm, WV (2011)			7.43	132	264
Mount Storm, WV (Fall 2008)	35.2	7/20/08-10/12/08	6.62	82	164
Wolfe Island, Ont (July-December 2009)			6.42	86	197.8
Wolfe Island, Ont (July-December 2009)			6.42	86	197.8
Maple Ridge, NY (2008)			4.96	195	321.75
Noble Clinton, NY (2009)	1.9[C]	8/1/09-09/31/09	4.50	67	100
Casselman Curtailment, PA (2008)			4.40	23	35.4
Noble Altona, NY			4.34	65	97.5
Noble Ellenburg, NY (2009)	16.1[C]	8/16/09-09/15/09	3.91	54	80
Noble Bliss, NY (2009)			3.85	67	100
Lempster, NH (2010)			3.57	12	24
Noble Ellenburg, NY (2008)			3.46	54	80
Noble Clinton, NY (2008)	2.1[C]	8/8/08-09/31/08	3.14	67	100
Lempster, NH (2009)			3.11	12	24
Mars Hill, ME (2007)			2.91	28	42
Wolfe Island, Ont (July-December 2011)			2.49	86	197.8
Noble Chateaugay, NY			2.44	71	106.5
High Sheldon, NY (2010)			2.33	75	112.5
Beech Ridge, WV			2.03	67	100.5
Munnsville, NY (2008)			1.93	23	34.5
High Sheldon, NY (2011)			1.78	75	112.5
Stetson Mountain II, ME (2010)			1.65	17	25.5

Appendix G. Comparable activity and fatality data for bats for the Shoenfeld estimator from publicly-available studies at wind energy facilities in North America, separated by geographic region.

Wind Energy Facility	Bat Activity Estimate[A]	Bat Activity Dates	Fatality Estimate[B]	No. of Turbines	Total MW
Stetson Mountain, ME (2009)	28.5; 0.3[H]	7/10/09-10/15/09	1.40	38	57
Mars Hill, ME (2008)			0.45	28	42
Stetson Mountain I, ME (2011)			0.28	38	57
Kibby, ME (2011)			0.12	44	132
Southwest					
Dry Lake I, AZ	8.8	4/29/10-11/10/10	4.29	30	63
Dry Lake II, AZ	11.5	5/11/11-10/26/11	1.66	31	65
Rocky Mountains					
Summerview, Alb (2008)	7.65[D]	07/15/06-07-09/30/06-07	11.42	39	70.2
Summerview, Alb (2006)			10.27	39	70.2
Judith Gap, MT (2006/2007)			8.93	90	135
Foote Creek Rim, WY (Phase I; 1999)			3.97	69	41.4
Judith Gap, MT (2009)			3.2	90	135
Foote Creek Rim, WY (Phase I; 2001-2002)	2.2[D,E]	6/15/01-9/1/01	1.57	69	41.4
Foote Creek Rim, WY (Phase I; 2000)	2.2[D,E]	6/15/00-9/1/00	1.05	69	41.4
California					
Shiloh I, CA			3.92	100	150
Shiloh II, CA			2.72	75	150
High Winds, CA (2004)			2.51	90	162
Dillon, CA			2.17	45	45
High Winds, CA (2005)			1.52	90	162
Alta Wind I, CA (2011)	4.42	6/26/2009 - 10/31/2009	1.28	100	150
Diablo Winds, CA			0.82	31	20.46
Alite, CA			0.24	8	24
Alta Wind II-V, CA (2011)	0.78	6/26/2009 - 10/31/2009	0.08	190	570

Appendix G. Comparable activity and fatality data for bats for the Shoenfeld estimator from publicly-available studies at wind energy facilities in North America, separated by geographic region.

Wind Energy Facility	Bat Activity Estimate[A]	Bat Activity Dates	Fatality Estimate[B]	No. of Turbines	Total MW
Pacific Northwest					
Biglow Canyon, OR (Phase II; 2009/2010)			2.71	65	150
Nine Canyon, WA			2.47	37	48.1
Stateline, OR/WA (2003)			2.29	454	299
Elkhorn, OR (2010)			2.14	61	101
White Creek, WA (2007-2011)			2.04	89	204.7
Biglow Canyon, OR (Phase I; 2008)			1.99	76	125.4
Leaning Juniper, OR			1.98	67	100.5
Big Horn, WA			1.90	133	199.5
Combine Hills, OR			1.88	41	41
Linden Ranch, WA			1.68	25	50
Pebble Springs, OR			1.55	47	98.7
Hopkins Ridge, WA (2008)			1.39	87	156.6
Harvest Wind, WA (2010-2012)			1.27	43	98.9
Elkhorn, OR (2008)			1.26	61	101
Vansycle, OR			1.12	38	24.9
Klondike III (Phase I), OR			1.11	125	223.6
Stateline, OR/WA (2002)			1.09	454	299
Stateline, OR/WA (2006)			0.95	454	299
Tuolumne (Windy Point I), WA			0.94	62	136.6
Klondike, OR			0.77	16	24
Combine Hills, OR (2011)			0.73	104	104
Hopkins Ridge, WA (2006)			0.63	83	150
Biglow Canyon, OR (Phase I; 2009)			0.58	76	125.4
Biglow Canyon, OR (Phase II; 2010/2011)			0.57	65	150
Hay Canyon, OR			0.53	48	100.8
Klondike II, OR			0.41	50	75
Windy Flats, WA			0.41	114	262.2
Vantage, WA			0.40	60	90
Wild Horse, WA			0.39	127	229
Goodnoe, WA			0.34	47	94
Marengo II, WA (2009)			0.27	39	70.2
Biglow Canyon, OR (Phase III; 2010/2011)			0.22	76	174.8
Marengo I, WA (2009/2010)			0.17	78	140.4
Klondike IIIa (Phase II), OR			0.16	51	76.5
Kittitas Valley, WA (2011-2012)			0.12	48	100.8

A = Bat passes per detector-night
B = Number of fatalities per megawatt per year
C = Activity rate based on data collected at various heights all other activity rates are from ground-based units only
D = Activity rate was averaged across phases and/or years
E = Activity rate calculated by WEST from data presented in referenced report
F = Activity rate based on pre-construction monitoring; data for all other activity and fatality rates were collected concurrently
G = Activity rate based on data collected from ground-based units excluding reference stations during the spring, summer, and fall seasons
H = The overall activity rate of 28.5 is from reference stations located along forest edges which may be attractive to bats; the activity rate of 0.3 is from one unit placed on a nacelle

Appendix G (*continued*). Comparable activity and fatality data for bats from publicly-available studies at wind energy facilities in North America (Shoenfeld estimator).

Facility	Activity Estimate	Fatality Estimate	Facility	Activity Estimate	Fatality Estimate
Big Blue, MN		This study			
Grand Meadow, MN		This study			
Oak Glen, MN		This study			
Alite, CA		Chatfield et al. 2010	Kewaunee County, WI		Howe et al. 2002
Alta Wind I, CA (11)	Solick et al. 2010	Chatfield et al. 2012	Kibby, ME (11)		Stantec 2012
Alta Wind II-V, CA (11)	Solick et al. 2010	Chatfield et al. 2012	Kittitas Valley, WA (11-12)		Stantec Consulting Services 2012
Barton I&II, IA		Derby et al. 2011a	Klondike, OR		Johnson et al. 2003
Barton Chapel, TX		WEST 2011	Klondike II, OR		NWC and WEST 2007
Beech Ridge, WV		Tidhar et al. 2013	Klondike III (Phase I), OR		Gritski et al. 2010
Big Horn, WA		Kronner et al. 2008	Klondike IIIa (Phase II), OR		Gritski et al. 2011
Big Smile, OK		Derby et al. 2013a	Leaning Juniper, OR		Gritski et al. 2008
Biglow Canyon, OR (Ph. I; 08)		Jeffrey et al. 2009a	Lempster, NH (09)		Tidhar et al. 2010
Biglow Canyon, OR (Ph. I; 09)		Enk et al. 2010	Lempster, NH (10)		Tidhar et al. 2011
Biglow Canyon, OR (Ph. II; 09/10)		Enk et al. 2011a	Linden Ranch, WA		Enz and Bay 2011
Biglow Canyon, OR (Ph. II; 10/11)		Enk et al. 2012b	Locust Ridge, PA (Ph. II; 09)		Arnett et al. 2011
Biglow Canyon, OR (Ph. III; 10/11)		Enk et al. 2012a	Locust Ridge, PA (Ph. II; 10)		Arnett et al. 2011
Blue Sky Green Field, WI	Gruver 2008	Gruver et al. 2009	Maple Ridge, NY (06)		Jain et al. 2007
Buffalo Gap I, TX		Tierney 2007	Maple Ridge, NY (07)		Jain et al. 2009a
Buffalo Gap II, TX		Tierney 2009	Maple Ridge, NY (08)		Jain et al. 2009d
Buffalo Mountain, TN (00-03)	Fiedler 2004	Nicholson et al. 2005	Marengo I, WA (09)		URS Corporation 2010b
Buffalo Mountain, TN (05)		Fiedler et al. 2007	Marengo II, WA (09)		URS Corporation 2010c
Buffalo Ridge, MN (Ph. I; 99)		Johnson et al. 2000	Mars Hill, ME (07)		Stantec 2008
Buffalo Ridge, MN (Ph. II; 98)		Johnson et al. 2000	Mars Hill, ME (08)		Stantec 2009a
Buffalo Ridge, MN (Ph. II; 99)		Johnson et al. 2000	Moraine II, MN		Derby et al. 2010d
Buffalo Ridge, MN (Ph. II; 01/Lake Benton I)	Johnson et al. 2004	Johnson et al. 2004	Mount Storm, WV (Fall 08)	Young et al. 2009b	Young et al. 2009b
Buffalo Ridge, MN (Ph. II; 02/Lake Benton I)	Johnson et al. 2004	Johnson et al. 2004	Mount Storm, WV (09)	Young et al. 2009a, 2010b	Young et al. 2009a, 2010b
Buffalo Ridge, MN (Ph. III; 99)		Johnson et al. 2000	Mount Storm, WV (10)	Young et al. 2010a, 2011b	Young et al. 2010a, 2011b
Buffalo Ridge, MN (Ph. III; 01/Lake Benton II)	Johnson et al. 2004	Johnson et al. 2004	Mount Storm, WV (11)		Young et al. 2011a, 2012b
Buffalo Ridge, MN (Ph. III; 02/Lake Benton II)	Johnson et al. 2004	Johnson et al. 2004	Mountaineer, WV (2003)		Kerns and Kerlinger 2004
Buffalo Ridge I, SD (10)		Derby et al. 2010b	Munnsville, NY (08)		Stantec 2009b
Buffalo Ridge II, SD (11)		Derby et al. 2012a	Nine Canyon, WA		Erickson et al. 2003
Casselman, PA (Spring and Fall 08)		Arnett et al. 2009a	Noble Altona, NY		Jain et al. 2011b
Casselman, PA (09)		Arnett et al. 2010	Noble Bliss, NY (08)		Jain et al.2009e
Casselman Curtailment, PA (08)		Arnett et al. 2009b	Noble Bliss, NY (09)		Jain et al. 2010a
Cedar Ridge, WI (09)	BHE Environmental 2008	BHE Environmental 2010	Noble Chateaugay, NY		Jain et al. 2011c
Cedar Ridge, WI (10)	BHE Environmental 2008	BHE Environmental 2011	Noble Clinton, NY (08)	Reynolds 2010a	Jain et al. 2009c
Cohocton/Dutch Hill, NY (09)		Stantec 2010	Noble Clinton, NY (09)	Reynolds 2010a	Jain et al. 2010b
Cohocton/Dutch Hill, NY (10)		Stantec 2011	Noble Ellenburg, NY (08)		Jain et al. 2009b
Combine Hills, OR		Young et al. 2006	Noble Ellenburg, NY (09)	Reynolds 2010b	Jain et al. 2010c
Combine Hills, OR (11)		Enz et al. 2012	Noble Wethersfield, NY		Jain et al. 2011a
Crescent Ridge, IL		Kerlinger et al. 2007	NPPD Ainsworth, NE		Derby et al. 2007
Criterion, MD (11)		Young et al. 2012a	Pebble Springs, OR		Gritski and Kronner 2010b
Criterion, MD (12)		Young et al. 2013	Pioneer Prairie, IA (Ph. II)		Chodachek et al. 2012
Crystal Lake II, IA		Derby et al. 2010a	PrairieWinds ND1 (Minot), ND		Derby et al. 2011c
Diablo Winds, CA		WEST 2006, 2008	PrairieWinds ND1 (Minot), ND (11)		Derby et al. 2012c
Dillon, CA		Chatfield et al. 2009	PrairieWinds SD1, SD		Derby et al. 2012d
Dry Lake I, AZ	Thompson et al. 2011	Thompson et al. 2011	Red Hills, OK		Derby et al. 2013b
Dry Lake II, AZ	Thompson and Bay 2012	Thompson and Bay 2012	Ripley, Ont (08)		Jacques Whitford 2009
Elkhorn, OR (08)		Jeffrey et a. 2009b	Rugby, ND		Derby et al. 2011b
Elkhorn, OR (10)		Enk et al. 2011b	Shiloh I, CA		Kerlinger et al. 2009

Appendix G (*continued*). Comparable activity and fatality data for bats from publicly-available studies at wind energy facilities in North America (Shoenfeld estimator).

Facility	Activity Estimate	Fatality Estimate
Elm Creek, MN		Derby et al. 2010c
Elm Creek II, MN		Derby et al. 2012b
Foote Creek Rim, WY (Ph. I; 99)		Young et al. 2003a
Foote Creek Rim, WY (Ph. I; 00)	Gruver 2002	Young et al. 2003a, 2003b
Foote Creek Rim, WY (Ph. I; 01-02)	Gruver 2002	Young et al. 2003a, 2003b
Forward Energy Center, WI	Watt and Drake 2011	Grodsky and Drake 2011
Fowler I, IN (09)		Good et al. 2011
Fowler III, IN (09)		Good et al. 2011
Fowler I, II, III, IN (10)		Good et al. 2011
Fowler I, II, III, IN (11)		Good et al. 2012
Fowler I, II, III, IN (12)		Good et al. 2013
Goodnoe, WA		URS Corporation 2010a
Grand Ridge, IL		Derby et al. 2010g
Harrow, Ont. (10)		NRSI 2011
Harvest Wind, WA (10-12)		Downes and Gritski 2012a
Hay Canyon, OR		Gritski and Kronner 2010a
High Sheldon, NY (10)		Tidhar et al. 2012a
High Sheldon, NY (11)		Tidhar et al. 2012b
High Winds, CA (04)		Kerlinger et al. 2006
High Winds, CA (05)		Kerlinger et al. 2006
Hopkins Ridge, WA (06)		Young et al. 2007
Hopkins Ridge, WA (08)		Young et al. 2009c
Judith Gap, MT (06-07)		TRC 2008
Judith Gap, MT (09)		Poulton and Erickson 2010
Shiloh II, CA		Kerlinger et al. 2010
Stateline, OR/WA (02)		Erickson et al. 2004
Stateline, OR/WA (03)		Erickson et al. 2004
Stateline, OR/WA (06)		Erickson et al. 2007
Stetson Mountain, ME (09)	Stantec 2009c	Stantec 2009c
Stetson Mountain I, ME (11)		Normandeau Associates 2011
Stetson Mountain II, ME (10)		Normandeau Associates 2010
Summerview, Alb (06)		Brown and Hamilton 2006
Summerview, Alb (08)	Baerwald 2008	Baerwald 2008
Top of Iowa, IA (03)		Jain 2005
Top of Iowa, IA (04)	Jain 2005	Jain 2005
Tuolumne (Windy Point I), WA		Enz and Bay 2010
Vansycle, OR		Erickson et al. 2000
Vantage, WA		Ventus 2012
Wessington Springs, SD (09)		Derby et al. 2010f
Wessington Springs, SD (10)		Derby et al. 2011d
White Creek, WA (07-11)		Downes and Gritski 2012b
Wild Horse, WA		Erickson et al. 2008
Windy Flats, WA		Enz et al. 2011
Winnebago, IA		Derby et al. 2010e
Wolfe Island, Ont (Jul-Dec 09)		Stantec Ltd. 2010
Wolfe Island, Ont (Jul-Dec 10)		Stantec Ltd. 2011
Wolfe Island, Ont (Jul-Dec 11)		Stantec Ltd. 2012